THE GAS JOURNAL

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A Glance at the Contents—

Distribution Superintendent Required.

Applications are invited for the position of Distribution Superintendent to the Godalming Gas and Coke Company. [p. 477.]

Distribution Manager Required.

The Directors of the Gloucester Gas Light Company invite applications for the position of Distribution Manager. [p. 477.]

The New Mossley Gas-Works.

In a paper before the Manchester and District Junior Gas Association, Mr. T. Hibbs described some of the features of the new Mossley Gas-Works. [p. 468.]

Sheffield Gas Company's Bill.

The proceedings are continued of the Sheffield Gas Company's Bill before the House of Lords Committee in connection with the South Yorkshire gas grid scheme. [p. 469.]

National Gas Council.

A Meeting of the Central Executive Board of the National Gas Council was held on May 8, when Sir David Milne-Watson was again nominated for the office of President. [p. 442.]

New Showrooms at Battersea.

New showrooms for the Gas Light and Coke Company were opened in Battersea Park Road, S.W. 11, on May 15, by His Worship the Mayor of Battersea (Councillor J. A. Campbell, J.P.). [p. 443.]

Midland Junior Gas Association.

The annual business meeting of the Midland Junior Gas Association was held in Birmingham on May 3, when Mr. R. S. Ramsden, President of the Midland Association of Gas Engineers, gave an address. [p. 467.]

A Lighting Research Laboratory.

A contribution by Mr. P. Crawford Sugg, B.Sc., of the Research Department of Messrs. William Sugg & Co., Ltd., gives details regarding the lay-out and equipment of a lighting research laboratory. [p. 446.]

London and Southern District Junior Association.

The annual business meeting of the London and Southern District Junior Gas Association was held on May 4 under the Presidency of Mr. H. C. Sims, of the South Metropolitan Gas Company. [p. 466.]

Steaming in Horizontal Retorts.

An important paper by Mr. H. D. Madden and the works technical staff of the Cardiff Gas Light and Coke Company gives the results of an investigation into the possibilities of steaming in horizontal retorts. [p. 451.]

Gas Research Fellowship.

The University of Leeds announces that applications will be received up to June 2 for an Open Fellowship of £200 per annum established by the Institution of Gas Engineers for the prosecution of post-graduate research in Gas Chemistry. [p. 480.]

Wales and Monmouthshire Association.

The Twenty-Ninth Annual Meeting of the Association was held at Cardiff on May 17, when an interesting resolution to provide for longer representation by individual members of the Association on the Institution Council was unanimously adopted. [p. 449.]

Utilization of Coke Oven Gas.

In a paper before the Institute of Fuel, Major M. Koopman, of the United Steel Companies, Ltd., drew attention to one particular direction in which there are possibilities of improvement—namely, the more extensive utilization of coke oven gas. [p. 457.]

Forthcoming Engagements

May 25.—SOUTHERN ASSOCIATION.—Visit to Watson House and Fulham Stove Shops of the Gas Light and Coke Company.
May 26.—NORTH OF ENGLAND ASSOCIATION (AUXILIARY SECTION).—Half-yearly meeting at Sunderland.
May 31.—B.C.G.A.—Yorkshire District Conference at Harrogate.
June 1.—B.C.G.A.—Eastern District Conference at Lincoln.
June 5-8.—I.G.E.—Annual General Meeting, London.
June 14.—S.B.G.I.—Council Meeting, 11.15 a.m.
June 20.—B.C.G.A.—Meeting of Executive Committee, 12 noon.
June 29.—WAVERLEY ASSOCIATION OF GAS MANAGERS.—Annual Meeting in Edinburgh.
Sept. 6.—NORTH BRITISH ASSOCIATION OF GAS MANAGERS.—Annual Meeting in Inverness.
Sept. 24-26.—B.C.G.A.—Annual General Meeting and Conference at Sheffield.
Nov. 6 and 7.—I.G.E.—Autumn Research Meeting.

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Page 62. SOUTH METROPOLITAN. F. G. Brewer appointed S.
Page 68. TORQUAY. R. C. Taylor appointed E. & M.

EDITORIAL NOTES

Gas Grids

SIX years ago there was a vast amount of exaggerated Press publicity—not necessarily disinterested—both in this country and on the Continent regarding long-distance supply of surplus coke oven gas. It was practically suggested that conditions applicable to Germany apply with equal force here, whereas, in fact, they are not at all comparable. In Germany the Gas Industry is smaller and the coke oven industry larger than in Great Britain, where gas prices are lower and the consumption per head of population is much higher. Again, in this country the majority of coke ovens are associated with collieries, while in Germany they are for the most part in close proximity to large steel works. Then one has to bear in mind that the Gas industry has progressed enormously in regard to plant equipment and efficiency of carbonization; on the other hand, the coke oven industry in this country has not on the whole progressed in like fashion, due to the depression in the iron and steel industry.

In 1928—and before then—the coke oven owners maintained that it was impossible for them to contemplate the cost of reconstruction of their plant unless they could sell the greater quantity of the surplus gas which would be available after reconstruction—a sensible argument provided the plants were to be constructed at the pit-head. In the "JOURNAL" for Sept. 26, 1928, we made the following comment: "Though we think that the place for the coke oven is adjacent to the steel works—that only in this way will the nation reap the greatest economic advantage—we understand also that there may be circumstances which demand that the Gas Industry would be well advised, in the broadest sense, to purchase surplus coke oven gas. *It is essential, however, that each case should be surveyed on its own merits.*" We maintained, as we still believe, that narrow prejudice on the part of either the coke oven industry or the Gas Industry must not be allowed to interfere with the solution of the problem and thus with the ultimate benefit of the public. At the time, however, the coke oven industry in general did not sufficiently appreciate the obligations under which the Gas Industry labours, and even now the understanding might be much more complete.

During the past six years a good deal of progress has been made, though current thought in some circles regards it as ridiculously slow. There has been the setting-up of a gas grid in South Yorkshire, which appears to be the only suitable area in this county for such an enterprise. And, of course, there has been much violent criticism of the grid, the contention being that the Gas Industry is holding up its development. As a matter of fact, "grids" in general have had such prominence that many regard a gas grid—and insist on a huge grid—as an economic solution to national fuel problems. Those who hold this view are far too optimistic; they certainly cannot have read at all closely the reasoned report of the Area Gas Supply Committee. The opinion is too often expressed that we are far behind Germany, Belgium, France, Holland, and America in not having at the present a grandiose grid. In Germany coal had to be hauled by rail over long distances, and the majority of German gas coals are inferior to our own. In England, on the other hand, rail hauls for gas coals are relatively short, and much coal can be transported very cheaply by boat. Other conditions in the other countries quoted are not comparable with our own. But it is quite a mistake to think we are such laggards in the matter of utilizing coke oven gas for domestic and industrial purposes. Even if there is only one grid in Great Britain—and the development of this grid is in its very early stages—the coke oven industry is selling to gas undertakers half as much as Germany is selling and more than Belgium is selling. The impression that very little is being done about the South Yorkshire grid is also a mistaken one. Within two years three fresh coke oven plants began to supply gas, for which purpose 12½ miles of new main were laid; 9 miles of main are also being laid to connect up with another coke oven plant and to make a second connection to one of the existing ones, and plans are under consideration for laying 7¼ miles of mains to connect to two more coke plants. All the while the efficient research, sales, and distribution organization of the Sheffield Gas Company is resulting in greatly increased industrial business.

What Has Been Done?

THROUGHOUT, a great deal of "JOURNAL" space has been devoted to this obviously important question of the utilization of coke oven gas. To-day's issue is an example. We publish the greater part of a paper by Major Koopman, Chief Fuel Engineer to the United Steel Companies, Ltd., presented at a truly representative gathering of those concerned with fuel problems—members of the Institute of Fuel, the Institution of Gas Engineers, the Coke Oven Managers' Association, the Institution of Mining Engineers, and the Colliery Managers' Association. The meeting was held under the auspices of the Institute of Fuel, which body has provided a platform for many remarkably valuable discussions on subjects which directly affect the Gas Industry. Both the paper by Major Koopman and the discussion to which it gave rise—and of which we give a full report—are of the greatest interest. Through them our readers will gain an excellent picture of the present position of coke oven gas utilization and also of likely future policy.

Major Koopman, in urging the greater use of coke oven gas in this country, maintains that no speculative experiment is being advocated, but a course of action the ultimate success of which would be practically guaranteed. The grounds for his claim are the extensive systems which have grown up on the Continent. We have already given our views on the frailty of such a foundation, with which most of our readers will, we think, agree. Both the paper and the discussion confirm the opinions on the best policy to adopt which we expressed in the "JOURNAL" six years ago—that coke ovens should be linked with blast furnaces and steel works. Recently co-ordinated schemes have been worked out and put into operation in a number of instances. Outstanding examples are the Normanby Park Steelworks at Scunthorpe, Richard Thomas & Co., also at Scunthorpe, Thos. Firth & John Brown, Ltd., at Sheffield, the Consett Iron Company at Durham, and the United Steel Companies, Ltd.

An Efficient Combination

AT Normanby Park, which is a compound works, blast furnaces are in operation and blast furnace gas is available for heating the new coke oven battery—at present the only battery of ovens fired by blast furnace gas in this country. By this means sufficient extra coke oven gas is released to enable the steel furnaces to be fired with a mixture of blast furnace and coke oven gases. Major Koopman observes that, while it is economical under the conditions prevailing locally to utilize all the coke oven gas in the works, as there is no means of disposal outside, yet the gas burned under the boilers could be replaced, if necessary, by an inferior fuel. Probably, if the plant were working at full capacity, there would be sufficient blast furnace gas available for the purpose. He concludes that this would leave an annual surplus of something like 1,000 million c.ft. of coke oven gas for disposal—if there were any means of disposal.

Now this statement is of importance, because, while

Major Koopman believes that conditions are not really favourable either in West Yorkshire or in Lancashire for the setting up of a grid, the Cleveland area has possibilities. This is an important iron and steel manufacturing district, and the suggestion that a grid should be established there has been put forward on several occasions recently. Major Koopman pre-supposes that a large quantity of surplus gas would be available, doubtless basing his supposition on the figures he gives for Normanby Park. At Normanby, however—and this was pointed out by Mr. Webber in the discussion—very lean Lincolnshire ores are being smelted and the coke consumption is from 20 to 25% above the consumption in other parts of the country with equally good practice but using different ores. A 25% reduction of the hourly output of coke oven gas at these works would practically eliminate the balance of 132,000 c.ft. an hour which is used on the boilers, and which it is suggested could be distributed as surplus. Arguing thus—and, it seems to us, perfectly legitimately—this eliminates the Cleveland district as one in which a coke oven gas grid could economically be established in connection with iron and steel manufacture. We are driven to the conclusion that if the wise policy is followed in Cleveland of erecting coking plant next to the blast furnaces, on the lines followed at Normanby Park, with reasonably good coking practice there will be little or no surplus coke oven gas available for outside distribution. And if there remain at the present day those who doubt whether coke oven gas is a suitable medium for firing re-heating furnaces we refer them to the experience at the Templeborough Works, about which Major Koopman is so enthusiastic.

Coke Ovens at the Pit Head

We arrive at the point, then, that the assumption that the future of a gas grid links itself to a vital extent with the iron and steel industry is not justified, and that attention should be directed to other possibilities—the purchase by gas undertakings of coke oven gas made in plants situated at the collieries. As we see it, reconstruction of such plants will be made following a policy of manufacturing not only blast furnace coke, but domestic smokeless fuel. In regard to blast furnace coke, Major Koopman mentions that, with a return to more normal trade conditions, the shortage of blast furnace coke and the deterioration in its quality are proving a serious handicap to blast furnaces not possessing their own coke ovens. "Outputs of blast furnaces are being restricted and coke consumptions are increasing, despite the improved demand for pig iron." Obviously the need for reconstructed ovens is there; and that a satisfactory domestic fuel can be made in specially designed modern coke ovens seems beyond doubt. This domestic fuel will, of course, be in direct competition with gas coke, and, at the same time, gas undertakings will be asked to buy the coke oven gas which will be surplus. In this connection we make two points. The first, brought out by Dr. E. W. Smith in the discussion, that a gas undertaking cannot be dependent on the supply of coke oven gas from a single coking plant. This implies that coking plants should be linked up in the form of small grids so that, should there be any trouble at individual coke ovens, there would still be certainty of supply from the others. The other point is that the Gas Industry cannot afford to regard with complacency the attack on all sides of its present coke position.

Steaming in Horizontals

The extent to which dilution by water gas can be carried out when making gas of a given declared calorific value depends upon the calorific value of the straight coal gas made; and a high thermal yield of hydrocarbons in coal gas depends on correct heat treatment of the tarry vapours. It is necessary to maintain a balance between "over-cracking" and "under-cracking." This subject has had much prominence in our columns during recent months as a result of the important work on continuous vertical retorts at Birmingham. The matter of controlled cracking in horizontal retorts is dealt with by the Engineer and Works Technical Staff of the Cardiff Gas Light and Coke Company in the "Journal" to-day. In this connection the Industry is greatly indebted to Mr. Madden, who, while serving as a member of the Fuel Research Board, suggested that the steaming of horizontal retorts might profitably be re-examined "to ascertain definitely if the nascent hydrocarbon vapours from the charge could be preserved from degradation through contact with the heated crown of the retort by the intervention of steam in the last few hours of the carbonizing period."

As our readers are aware, the Fuel Research Board undertook an investigation on steaming in horizontal retorts, and the results were given by Dr. Sinnatt in his memorable William Young Memorial Lecture last September. Employing normal horizontal retorts with 12 cwt. charges it has been found possible to introduce steam over the last three hours without marked influence on combustion chamber temperature. The result of this has been to raise the yield of gas from 75 to 87 therms per ton. This was achieved without special methods of charging, but the retorts were fairly full of coal. Commenting on the lecture we expressed the hope that we should later be able to publish a paper dealing specially with steaming in horizontal retorts—a hope fulfilled by the contribution on later pages. In the Fuel Research Board's tests about 80% of the steam was decomposed by passing through the incandescent coke. The idea at Cardiff is to steam the free space. For the origin of the idea we have to go back to 1918, when the late Mr. W. Doig Gibb, who was then assisting Lord Moulton at the Ministry of Munitions, asked Mr. Madden to consider if anything could be done to obtain more oils from coal-tar in gas-works. Consideration was given to the degradation of nascent gases in the free space—*i.e.*, between the charge and the heated crown of the retort. It was thought that if a stratum of steam could be so introduced that it shielded the nascent hydrocarbons from the hot surface of the retort a tar containing a higher oil content might be produced. The war ended shortly after a supply of steam for this purpose was arranged at the Grangetown Works, and re-conditioning of the works after the war period resulted in discontinuance of the experiments.

New Work at Cardiff

A fresh start was made with the investigation at Cardiff concurrently with the experiments at the Fuel Research Station, and it is with this investigation that Messrs. Boardman, Williams, and Kleist are concerned in their present paper. The object was the production of a tar containing a higher oil content—an object which was not achieved by steaming the charge for a couple of hours. "Probably," state the authors, "if it were possible to steam the full eight hours a different tar might be produced." But it is only at the end of the carbonizing period that the steaming results in a higher thermal yield; and the idea of steaming horizontal retorts for eight hours may be dismissed as impracticable. We are surprised at the following observation in the paper: "However, an exceptional result has been obtained, and that entirely unexpected—viz., an increase in the number of gaseous therms developed per ton of coal carbonized." We should have thought this to be quite a natural result of passing steam over incandescent coke. As stated previously, the thermal yield at the Fuel Research Station, where 80% of the steam was decomposed, increased by a matter of 12 therms per ton. In the coal testing plant at the Grangetown Works, where the steam has a travel of only 6-7 ft., an increase of 5½ therms per ton of coal carbonized was noted, and it is estimated that in the 20 ft. retorts, where the steam has an "extended travel through the nascent hydrocarbons," an additional 9-10 therms per ton are obtained. We suggest that this increase is accounted for almost wholly by the water gas reaction and that the shielding effect has very little to do with the matter, though it must play some small part. Without end period steaming—as will be seen from Table II. of the paper—the percentage of unsaturated hydrocarbons is higher than

with steaming, as also is the percentage of methane. The differences are due to water gas dilution, as will be gathered by comparing the hydrogen and carbon monoxide contents of the gas from non-steamed and end period steamed retorts.

Another thing which surprises us is that, in spite of the quantity of water gas made during the period of steaming—and it is a considerable quantity—the statement is made that the coke yield is the same whether steaming is or is not carried out. The carbon monoxide —the percentage with non-steaming is 6·8, with steaming 9·1 (Table II.)—must come from somewhere, and that it cannot be accounted for by interaction of the steam with the scurf is apparent from the authors' observations on scurfing. They explain that the distribution of the scurf was altered, but not its amount. " Instead of being evenly deposited throughout the length of the crown of the retort, there was practically no deposition after two months' working on the steaming side, but on the charging end there was an increase in the amount deposited as compared with normal working. Unfortunately, this shows that the working period of the retorts between scurfing had not been extended. Some improvement in this direction had been anticipated, but this was not so." Again referring to Table II., in only one steaming test is the coke yield given. Compared with the non-steaming coke yield, however, it does show a decrease of 31 lbs.

Having mentioned that a patent is now available for steaming stop-end retorts which merits adoption by works having this type of plant, the authors conclude their valuable paper by saying that the whole question of steaming in horizontal retorts is well worthy of further research—a statement with which we are in hearty agreement—" inasmuch as it tends to reduce the cost of carbonization as a result of a reduction in the quantity of coal carbonized and the increased output of the plant. . . ." It would have been useful if the authors could have given the cost of the " steamed " therm as distinct from the " straight " therm.

This question of increased output of plant is a highly important one; and we wonder how many undertakings have taken advantage of the work of the Fuel Research Board in this connection, outlined by Dr. Sinnatt in his William Young Memorial Lecture. We refer to raising the throughput by increasing the volume of the heating gases being circulated round the retorts. This technique, together with steaming, is being actively studied at the Fuel Research Station; the method enables the throughputs of horizontal settings to be increased to meet any special demands for an increased production of gas. Work such as this at East Greenwich and at Cardiff may well have far-reaching effects on methods of gas and coke manufacture.

Mystery

" In the whole scheme there is an air of Rip Van Winkledom . . . the flats are lit by gas." We take this remark from a book just published by Methuen & Company, on " Housing and Slum Clearance in London."

The Gas Light and Coke Company's Act of 1933 (which, of course, prevents Local Authorities from forcing their tenants to use electricity or gas) is attacked in the same book " on three important grounds of public policy." The last of these important grounds is that " the public should not be refused the benefits of modern science." Other references to gas and electricity are equally biased. One sentence begins, " Electricity, more than any other fuel or power, will mean ultimate economy. . . ." There is a full page of illustrations of " All Electric Houses." These are random selections from a book that might almost be taken for pro-electricity propaganda.

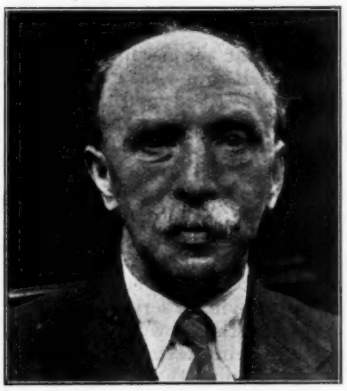
We were not unnaturally discouraged to find gas so poorly thought of by authors who have written what the publishers describe on the cover as " this very necessary book which aims at explaining clearly to those unacquainted with the true facts the extremely complicated circumstances which enmesh Slums, Landlords, Politicians, and Tenants."

We wondered what could have given close students of housing conditions among the poor so jaundiced (and so ill-informed) a view of the Gas Industry. Mr. Hugh Quigley and Miss Ismay Goldie are the authors concerned, and we cannot help asking if there are two gentlemen named Hugh Quigley. The only one whom we know by name is the Chief Statistical Officer of the Central Electricity Board. A search through " this very necessary book " has failed to set our curiosity at rest. But we did discover that Mr. Quigley, the Author of " Housing and Slum Clearance in London," states specifically in his Preface that he, and not Miss Goldie, wrote the chapter in which the Gas Light and Coke Company's Act is so sharply criticized. On the other hand, this criticism is, as we have said, based " on important grounds of public policy," and there is not a word to suggest that the writer is a paid official of the Central Electricity Board. Even if such an official wrote (as he perfectly justifiably might) as a private individual, his official position ought surely to be revealed for the benefit of " those unacquainted with the true facts "—the public for whom Messrs. Methuen are avowedly catering.

If we have overlooked some passage that clears the matter up, we apologise gladly and unreservedly to all concerned. If not, Messrs. Methuen and the Mr. Hugh Quigley of the C.E.B. will, no doubt, set our minds and those of our readers at rest.

PERSONAL

A PRESENTATION AT EDINBURGH.



Our photograph is of Mr. John R. Gray, Works Manager of Messrs. Alder & Mackay, Ltd., Gas Meter Manufacturers, Edinburgh, who was the recipient of a handsome chiming clock and a wallet from the Directors, on the occasion of having served fifty years with the Company. Mr. Gray was also presented with an illuminated address, signed by the foremen under his charge. Mr. Gray joined the Company and served under his father, Mr. William Gray, who had charge of the works at that time, in April, 1884. In 1901 Mr. Gray took over the position which he now holds and where he has had the satisfaction of seeing the steady growth of the business which now employs some 500 Edinburgh workpeople.

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The Gas Education Committee of the Institution of Gas Engineers has presented Mr. C. H. Creasey, H.M.I., with a miniature of the Order of the British Empire with which he was recently invested by H.M. the King on his retirement from the Board of Education. Mr. Creasey has been actively associated with the Education Scheme of the Institution since its inception and has consented to remain a member of the Gas Education Committee and so continue to render the valuable service which he has given in the past.

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Mr. J. Percy Plant has been elected Chairman of the Board of Management of the Birmingham section of the 1935 British Industries Fair in succession to Mr. C. E. Greener.

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On May 16 Mr. John D. Ashworth, son of Mr. J. D. Ashworth, Engineer and Manager to the Blackburn Corporation Gas Department, was married to Miss Ann Burke, of Blackburn. The bridegroom, who represents Messrs. West's Gas Improvement Company, Ltd., is stationed in Holland supervising the construction of gas-works.

THE NEWS OF THE WEEK

The Bristol Gas Company's new offices and showrooms, designed by Mr. H. Austin Hall, F.R.I.B.A., the consulting architect to the British Commercial Gas Association, will be ready by the end of this year. These new premises have become a necessity owing to the growth of the Company's business.

A Record Price was obtained for stock of the Stamford (Lincs.) Gas Light and Coke Company at an auction sale conducted by Messrs. Richardson, of Stamford, on May 18. For £140 worth of original stock in the concern Mr. Charles Dalton, of Stamford, the Vice-Chairman of the Company, paid £355, which is rather more than two-and-a-half times its face value.

Gas Supply in Brussels.—The report of the Société Bruxelloise du Gaz, Brussels, for 1933, states that the business of the Undertaking during the past twelve months showed very little change from that of 1932. The quantity of gas supplied to private consumers was practically equal in total to that of the preceding year. There was, however, an increase of about 5% in the number of consumers, so that there was a slight drop in the average quantity taken per consumer. The sales of gas for industrial purposes, on the other hand, increased to the extent of 12%.

We Have Received from the British Engineers' Association their classified handbook of members of the Association and their manufactures. This handbook should prove to be a valuable aid to engineers and a handy guide to industrialists. The chief object is to assist those wanting machinery or plant, or any other product of engineering industry, to satisfy their requirements. The B.E.A. will forward copies of the handbook, post free, to anyone interested in the purchase of British engineering plant, machinery, or accessories, on application to the Secretary, The British Engineers' Association, 32, Victoria Street, London, S.W. 1.

The Minehead Gas Light and Coke Company, Somerset, have just concluded a successful series of Gas Cookery Lectures, which were held in the local Women's Institute Hall.

Meters, Ltd., Manchester.—The Directors submit Accounts for the year ended March 31, 1934, showing a net profit amounting to £21,333, which added to the balance of £4,708 brought forward, gives a total of £26,042. After deducting the interim dividends amounting to £6,456 paid in November last, the amount now available for appropriation is £19,585. The Directors recommend: (*a*) The payment of final dividends for the year ended March 31, 1934, of 2¾% (actual) upon the preference stock, and of 6½% (actual) upon the ordinary stock, making the total dividends for the year 5½% upon the preference stock and 9% upon the ordinary stock (both *less* income-tax); (*b*) that £825 be added to the staff benevolent fund (making that fund £11,800); and (*c*) that the balance of £5,894 be carried forward to next year's accounts.

Institution of Gas Engineers.

Copies of the following British Standard Specifications may be obtained, price 2s. each, from the Secretary of the Institution of Gas Engineers:

No. 541-1934.—British Standard Technique for Determining the Rideal-Walker Coefficient of Disinfectants.

No. 554-1934.—Report on Standard Temperature of Volumetric Glassware.

No. 161-1934.—Tungsten Filament General Service Electric Lamps.

No. 4 A-1934.—Dimensions and Properties of British Standard Equal Angles, Unequal Angles, and T Bars for Structural Purposes. (Partly superseding No. 6-1924.)

In Institution Week

In addition to the Official Provisional Programme for the Institution Meeting which was published in the "JOURNAL" last week, members and others who will be in London for the occasion may be interested in particulars of other events taking place during the week in which they may like to participate. The following have been brought to our notice:

NATIONAL SMOKE ABATEMENT SOCIETY.

A meeting of the National Smoke Abatement Society will be held on Friday, June 8, at 71, Eccleston Square, S.W. 1, and will take the form of a symposium and discussions on smokeless solid fuels and their use in open grates.

The President of the Society, Dr. H. A. Des Vœux, will take the chair, and the discussion will be opened by short papers as detailed below:

11.0 a.m.
1. Natural Smokeless Fuels, by Mr. E. K. Regan.
2. Gas Coke, by Mr. E. W. L. Nicol.
3. Low-Temperature Carbonization Fuels, by Col. W. A. Bristow.
4. Coke Oven Fuel, by Mr. H. O. H. Cerckel.

2.30 p.m.
5. From the Housewife's Viewpoint, by Mrs. G. H. Miles.
6. Development and Marketing, by Dr. G. E. Foxwell.
7. Properties Required in Open-Grate Fuels, by Mr. John Roberts.
8. From the Viewpoint of National Economy, and Conclusion, by Dr. E. W. Smith.

The meeting will conclude at about 4.30 to 5 p.m., and it may be conveniently attended by those present at the 71st Annual General Meeting of the Institution of Gas Engineers, the business sessions of which terminate on the previous day.

AERIAL PHOTOGRAPHY AND AIR SURVEY EXHIBITION.

During the Institution Meeting, members may care to visit the Exhibition of Aerial Photography and Air Survey organized by Aerofilms Ltd., at Irving Hall, Bush House, W.C. 2, from Tuesday, June 5, to Friday, June 8, between 10 a.m. and 7 p.m., or on Saturday, June 9, from 10 a.m. to 1 p.m.

This Exhibition, which is the combined effort of all concerned with aerial photography and air survey, covers the uses of aerial photography for educational purposes and the application of economic air survey at home and abroad. The apparatus used will be on view, and many interesting exhibits have been contributed by the Air Ministry, War Office, Science Museum (Aviation Section), Royal Aeronautical Society, and others. There will be many unique exhibits, including the camera which took the Mount Everest photographs, models of aircraft, airports, &c.

Tickets of admission are not required.

A GOLF DAY.

The S.B.G.I. Golfing Circle is holding its Spring Meeting at Sudbrooke Park Golf Club, Richmond, Surrey, on Monday, June 4, and cordially invites golfing members of the Institution of Gas Engineers attending the Annual General Meeting of the Institution to take part in the competitions on that day.

During the day there will be 18 holes medal play for the "Thornton Victory Cup," with a separate prize for visitors presented by Mr. Frank P. Tarratt, and in the afternoon only, 18-hole foursomes against bogey, for prizes presented by a member of the Circle.

The start will be as soon after 9.30 a.m. as possible, and cards in both competitions are returnable by 6 p.m.

The Sudbrooke Park Course is conveniently situated, in beautiful surroundings, within a few minutes' taxi or omnibus journey from Richmond Station, which is served by frequent trains from Waterloo (Southern Railway), and by the District Railway. Caddies, lunch, and tea will be available at reasonable charges, and green fees will not be payable by visitors.

Members of the Institution wishing to enter are requested to apply, before May 31, to Mr. W. R. Edgar, the Hon. Secretary and Treasurer of the Circle, at Blenheim Works, Hammersmith, W. 6.

THE NEWS—*continued.*

British Commercial Gas Association.

Twenty-Third Annual General Meeting and Conference.

The Twenty-Third Annual General Meeting and Conference of the Association will be held in Sheffield from Sept. 24 to 26 next, inclusive, under the Presidency of Col. H. K. Stephenson, D.S.O., LL.D., J.P. The programme for the Conference will be circulated to members in due course.

Hotel accommodation in the city is strictly limited, and, accordingly, hotels recommended to delegates include some within easy reach of Sheffield. The Sheffield Gas Company have kindly undertaken to provide motor coach transport between certain of the hotels and the city. The Association regrets it is not able to undertake the reservation of hotel accommodation, and members are therefore advised to make immediate and direct application for the rooms they require.

National Gas Council.

Meeting of the Central Executive Board.

A Meeting of the Central Executive Board of the National Gas Council was held in the St. James' Room, Hotel Metropole, Northumberland Avenue, London, W.C. 2, on May 8—Sir DAVID MILNE-WATSON, LL.D., D.L., in the chair.

Nomination of Candidate for the Office of President.—Sir David Milne-Watson was again nominated for the office of President in accordance with Rule 41 (*d*) of the Constitution.

List of Members Appointed to the Central Executive Board.—The following alterations in membership of the Board were reported—viz., Mr. R. J. Milbourne, J.P., A.M.Inst.C.E., F.C.S. (Wellington (Salop), Lilleshall, and Bilston Gas Companies), elected at the Annual Meeting of the Midland District Executive Board in place of Mr. P. N. Langford, resigned. Col. H. K. Stephenson, D.S.O., LL.D., J.P. (Sheffield Gas Company), as a representative of the British Commercial Gas Association in place of Mr. J. E. Daw, J.P., who is now a Trustee of the Council.

Finance of the National Bodies.—The Board approved of the proposal which had been submitted to, and approved by, the Joint Finance Committee, to increase the subscription to the National Bodies to 10s. per million c.ft. of gas made, and it was decided that a communication notifying this decision should be sent out under the signatures of the Presidents of the National Bodies.

Gas Undertakings Bill.—The various stages of this Bill in Parliament were reported and considered.

It was reported that the President had that morning met a deputation from the non-statutory gas undertakings in Scotland, and the deputation had urged that representation should be made to the Board of Trade to exclude Scottish non-statutory undertakings from the operation of clause 7 of the Bill, upon the ground that section 21 of the Burghs Gas Supply (Scotland) Act, 1876, would, in effect, be repealed if this clause were applied to Scotland. It was decided by the Board to give their support to the proposal of the deputation of non-statutory gas undertakings in Scotland.

Petroleum Production Bill (*Clause* 4).—It was reported that this Bill had been read a second time and considered by a Committee of the whole House. The object of the Bill was to fix the property in petroleum in the Crown, and petroleum was so defined as to include natural gas. It was also provided that no person might search or bore for petroleum except in accordance with a licence granted by the Board of Trade. Clause 4 of the Bill provided that it should be lawful for any person holding a licence, if authorized by the Board of Trade, to supply natural gas to any premises, provided that, where the premises to be supplied were within the area of a statutory gas undertaking, the Board of Trade should not give the holder of the licence permission to supply such premises with gas unless the gas undertakers had been given an opportunity of purchasing the gas at a reasonable price, and further that gas was supplied to those premises for industrial purposes only. It was contended that it was objectionable for any authority or person to be authorized to supply gas to premises within the area of a statutory gas undertaking. It was decided that the officers and the President should interview the Board of Trade with regard to this matter.

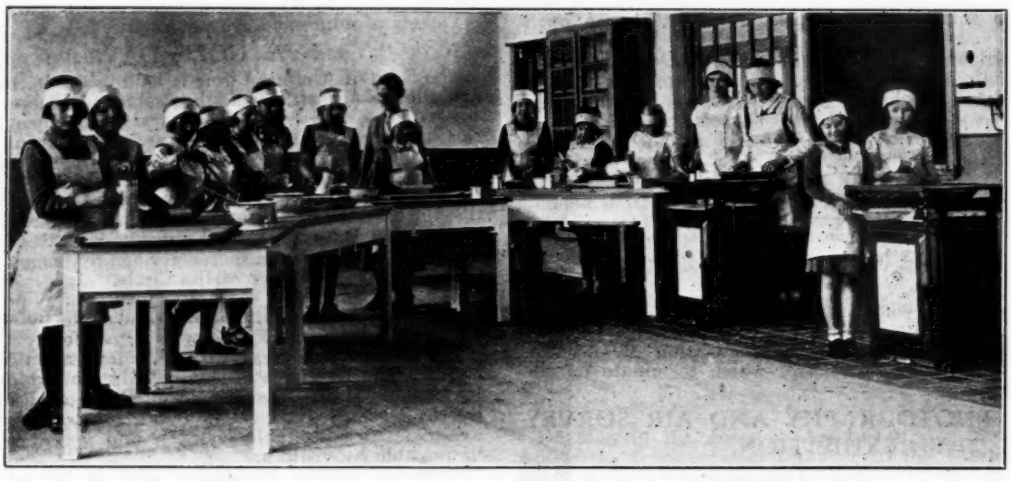
Building Industries National Council.—A letter was submitted from Sir Raymond Unwin stating that this Council, of which he was President, had decided to accept outside organizations as allied members. Members would be eligible to nominate representatives to specialist panels dealing with subjects such as Building Acts, Sanitation, Plumbing, and Water Installation, Lifts and Escalators Installation, and Fire Prevention. It was decided by the Board that the National Gas Council should apply for membership.

Association of Public Lighting Engineers.—Mr. George Braidwood, of Coatbridge, was nominated by the Board to attend the 11th Annual Meeting of the Conference to be held at Aberdeen from Sept. 17-21 next.

An Opportunity for Publicity Men.

The Regent Exhibition of 1934—"Advertising of To-day and To-morrow"—which is to be held at Bush House from Oct. 5 to 13, will give publicity men, with creative ideas, an opportunity of entering a sample of their work for what promises to be the big advertising event of the year. The object of the Exhibition is to bring to light advertising ideas to meet the needs of a rapidly changing world, and prizes worthy of such an event are to be awarded to those who display sufficient talent to merit them. It is to be hoped that the Gas Industry will be well represented, and we suggest that members of publicity departments should at all events apply for particulars to the Regent Advertising Club, 19, Buckingham Street, Adelphi, W.C. 2.

The Housewife of To-Morrow



Pupils in a fine up-to-date cookery classroom at Seaview Public Elementary School, Belfast, which was opened last week by the Right Rev. William Corkey, M.A., D.D., Moderator, General Assembly.

SIR ARTHUR DUCKHAM MEMORIAL FUND

Official List of Donations from May 12 to May 18

The Committee hope to be in a position to endow a "Duckham Research Award," to be applied for the period and purpose of specified investigations of interest to the Gas Industry, at places, at home or abroad, selected as being appropriate for the conduct of each particular investigation. Subscribers, therefore, are not only paying a tribute to the memory of Sir Arthur Duckham, but are also assisting to strengthen the Gas Industry at a critical period of its development.

Name and Town.	Amount. £ s. d.
Brighton Gas Company, Ltd., Australia	15 0 0
Borough of Chesterfield Gas Committee	21 0 0
Burton-upon-Trent Corporation	5 5 0
Eastern Counties Gas Managers' Association	5 5 0
R. E. Gibson, Liverpool	5 5 0
Gravesend and Milton Gas Light Company	8 0 0
Hinckley Urban District Council Gas Department	12 12 0
W. J. Jenkins & Co., Ltd., Retford	5 5 0
Macclesfield Corporation Gas Department	5 5 0
Manchester and District Junior Gas Association	2 2 0
Scottish Junior Gas Association (Eastern District)	1 1 0
Stamford and St. Martin's Gas Light and Coke Company	1 1 0
Mrs. N. E. Stevens, Birchington	0 5 0
Donations (13) paid above	£ 87 6 0
Donations (553) paid previously	9,365 3 6
Total Donations (566) paid	£9,452 9 6
Donations (11) promised	617 7 0
Total Donations (577) paid or promised	£10,069 16 6

New Gas Light Showrooms.

The First South of the River.

Stated by Sir David Milne-Watson to be the first new showrooms opened by the Company south of the river, and the fifty-fourth in all, attractive premises for the Gas Light and Coke Company were officially inaugurated in Battersea Park Road, S.W. 11, on May 15, by His Worship the Mayor of Battersea (Councillor J. A. Campbell, J.P.).

The new building is situated on an important thoroughfare near the junction of Latchmere Road and Battersea Bridge Road, and the street front has been carried out on simple modern lines, consisting of one large centre window, flanked by two entrance doors with two further smaller windows at each end. The Company are departing somewhat from their usual policy of the "open" window in that the central window is completely closed in and is devoted to specialized displays of appliances. The two smaller windows are arranged so that they may be left "open" if it is desired to give a view of the interior of the showroom, or, alternatively, closed by means of curtains for the purpose of individual displays.

With a view to making an appeal more particularly to the prepayment consumers, who are, by reason of the nature of the district, in a preponderance, the Company have had these showrooms designed on rather more simple lines than some of their larger premises, and have embodied many useful suggestions for running the smaller home easily and inexpensively.

A Departure from Practice.

The Company have also departed to a certain extent from their previous practice in making the interior of this showroom more "open"—that is to say, there is less definite sectionalization by means of separate and distinct rooms for the display of the various classes of apparatus—and a complete view of the whole showroom and almost all the appliances in it may be obtained immediately upon entering from the street.

Backing on the central display window is the water heating section, consisting of an alcove containing a series of instantaneous and small storage heaters of various types, all in operation, and arranged to discharge their hot water into a common polished steel trough.

The central display is the "gadget table," which is a recent innovation by the Company, previously described in these columns, and on this are set out all the portable appliances which can be "plugged-in" to gas.

A small counter for the payment of accounts is provided, while in course of completion is a commodious room at the rear of the showroom, which may possibly be utilized for cookery demonstrations, &c. The upper floors are devoted to offices for the district clerical staff and prepayment meter collectors.

The Opening Ceremony.

The opening ceremony was of a happily informal character and took place over the tea table, at which were gathered, at the invitation of the Gas Light and Coke Company, a large number of members of the Battersea Borough Council to support their Mayor (Councillor J. A. Campbell, J.P.), who was accompanied by the Mayoress, together with many prominent local residents.

Presiding over the proceedings was Sir David Milne-Watson, LL.D., D.L. (Governor of the Company), while among those also present to support him were Mr. R. W. Foot (General Manager), Mr. Thomas Hardie (Chief Engineer), Mr. S. Lacey (Controller of Gas Sales), and other senior officers of the Company, together with Mr. Walter Tapper, the Architect of the new building.

Gas-Heated Swimming Pool.

"Get up-to-date with gas" is no mere slogan at Coventry. This is evidenced at the new Gosford Swimming Pool. The water is maintained at a constant temperature by gas-heated appliances thermostatically controlled.

The thermostatic control employed is so sensitive that it is brought into immediate operation by a rise or fall in temperature of 1° F. Comfort is the keynote throughout, for, on leaving the warmed water, bathers enter dressing rooms heated by gas and maintained at a suitable temperature by similar control. This innovation, offering as it does the health of an open-air bath, combined with the comfort associated with the warmed water of an indoor bath, may well start a "Holiday at Home" movement.

Imperial Continental Gas Association.

Report of the Directors.

The Directors of the Imperial Continental Gas Association submit their report upon the trading results of the Association for the 110th year of its commercial activity, ended March 31, 1934, showing that the Association's stations and subsidiary and allied companies have made satisfactory profits, with the exception of the Cokeries du Brabant. Adequate provision has been made for the loss sustained by this latter Company. The holding in the Berliner Kraft und Licht Aktiengesellschaft has been sold on satisfactory terms.

The audited statement of accounts for the twelve months to March 31, 1934, shows that the balance to the credit of the profit and loss account was £514,270. To this has to be added the balance brought forward—namely, £485,312, making a total available for approximation to £999,582. Out of this balance there has been paid on the capital of £5,600,000 an interim dividend of 5%, less income-tax at 5s. in the £, leaving £789,582.

The Directors now recommend the payment of a final dividend of 7%, less income-tax at 4s. 6d. in the £, making a total dividend equivalent to 12%, less tax, for the year, leaving a balance of £485,782 to be carried forward.

Sir Henry Birchenough having resigned the Chairmanmanship of the Association, Sir Thomas Royden was, in January last, elected to the Chair, Sir Henry Birchenough reverting to the position of Deputy-Chairman. Under the

THE NEWS—*continued.*

By-Laws of the Association, Sir Henry Birchenough, Bart., K.C.M.G., Mr. H. G. Palmer, and Mr. S. H. Le Roy-Lewis retire from the Board by rotation. These gentlemen, being eligible, offer themselves for re-election.

Scottish Junior Gas Association.

(Eastern District.)

The Annual General Meeting of the Association was held in Heriot-Watt College, Edinburgh, on May 12, 1934. The membership has increased from 142 to 166 and the balance-sheet shows a sound financial position.

ELECTIONS TO OFFICE.

The election of Office-bearers for 1934-35 resulted in the following members being appointed:

President.—Mr. Sydney Smith, Dunfermline.
Vice-President.—Mr. A. J. Doran, Edinburgh.
Hon. Secretary and Treasurer.—Mr. A. C. Rea, Cloven-Eden, 20, Craigleith Hill Avenue, Edinburgh.
Librarian.—Mr. A. J. Doran, Granton Gas-Works, Edinburgh.
Council Members.—Messrs. Wm. Scott, Hamilton (*ex-officio*); J. M. Dow, Kirkcaldy; C. D. Blackhall, Edinburgh; Edward Alexander, Edinburgh (one year); Wm. Masterton, Edinburgh; Robt. Cowie, Jnr., Hawick; and Hector Brown, Dunfermline.

After the meeting, members visited the Workshops and Laboratory of the City of Edinburgh Lighting Department, where they were welcomed by Bailie Ritchie, Convener, Mr. Beveridge, Inspector, and his staff.

Yorkshire Junior Gas Association.

Visit to Staveley Works.

The final meeting of the session of the Yorkshire Junior Gas Association took place on May 16, when members, to the number of 60, visited the works of the Staveley Coal and Iron Company, Ltd., near Chesterfield, by invitation of the Directors of the Company, and inspected the sand-spun pipe plant.

The visitors were entertained at luncheon at the Hollingwood Hotel, where a hearty welcome was given them by Mr. H. H. Berresford, Commercial Manager to the Company. A vote of thanks for the Company's hospitality was accorded on the proposition of the President of the Association (Mr. B. Thorpe, of Huddersfield), seconded by Mr. J. W. Carlton (Shipley), the Junior Vice-President. Mr. J. B. Allan replied to the vote of thanks on behalf of the firm.

After lunch the party inspected the bye-product plant at the Company's Devonshire Works, and afterwards Mr. J. T. Haynes, Engineer and Manager to the Rotherham Gas Department, exhibited a cinematograph film showing pipe-laying work in progress at Rotherham with the Staveley flexible joint. Tea was subsequently served at the Hollingwood Hotel—again by invitation of the Directors of the Staveley Company.

CONTINENTAL NOTES

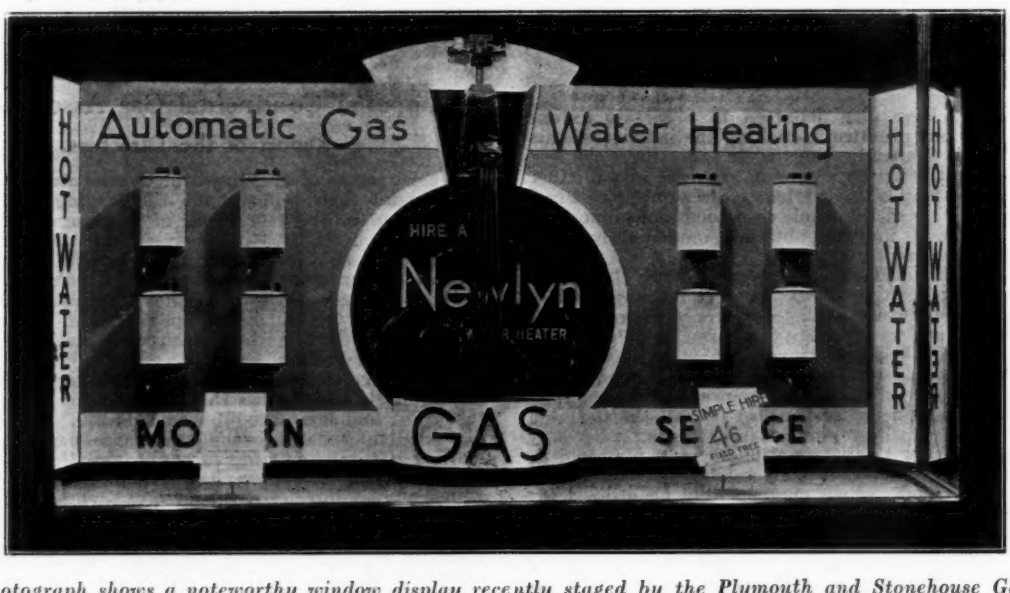
PRODUCTION OF ALCOHOL FROM ETHYLENE UNDER PRESSURE.

The effect of pressure on the interaction between ethylene and sulphuric acid with formation of ethyl sulphuric acid and diethyl sulphate has been studied by F. Strahler and F. Hachtel, the results of their investigations being reported in *Brennstoff-Chemie*, 1934, 15, 166-169 (May 1).

It was known from a patent in the name of Maimeri (E.P. 215,000) that increased pressure favours the reaction and leads to an economy in the amount of sulphuric acid needed due to the formation of a higher proportion of diethyl sulphate than is formed at atmospheric pressure. The optimum conditions had, however, not been disclosed.

The authors employed pure compressed ethylene in their investigation and state that there was no object in working with coal gas itself, since ethylene of 90% purity can readily be produced therefrom by liquefaction and fractionation.

The experiments were carried out in an autoclave of V_2A steel, fitted with a stirrer. The autoclave was charged with sulphuric acid, and ethylene was passed in for definite periods at a constant rate and under a constant pressure. The conditions were varied as follows: Pressure, 0, 5, 10, 15, and 20 atmospheres (gauge); temperature, 20, 40, 50, 60, and 70° C.; acid strength, 60, 63, and 66° Bé.; time, 6, 12, 24, 36, and 48 hours; gas rate, 2 to 4 litres of ethylene per hour per gramme molecule of sulphuric acid. The effect of various catalysts (cuprous chloride, silver sulphate, copper sulphate, potassium ferrocyanide, and ferric chloride) was also studied. The optimum conditions were found to be: Pressure, 15 atmospheres; acid strength, 66° Bé.; temperature, 70° C.; gas velocity, 4 litres of ethylene



Our photograph shows a noteworthy window display recently staged by the Plymouth and Stonehouse Gas Light and Coke Company in conjunction with a week's special water-heating campaign. The background of the display was of light blue, all the lettering being cut out of three-ply wood and mounted on a white background. The large tap and the tubes which represented the water were chromium plated. The centre recess was in black and the words "Hire a 'Newlyn' Water Heater" in green. Altogether an unusually attractive and dignified display.

THE NEWS—continued.

per hour per gramme molecule of sulphuric acid. None of the catalysts produced an increase in the total amount of ethylene absorbed though the ratio of diethyl sulphate to ethyl sulphuric acid was affected. The rate of absorption of ethylene was only improved in presence of a catalyst during the early stages of absorption.

When the reaction is carried out at a pressure of 15 atmospheres, the quantity of acid required to produce 1 lb. of alcohol is only about 2 lbs. as stated by Maimeri, though, at atmospheric pressure, the amount of acid required is 5 lbs. At a maximum, sulphuric acid can take up 0·4 times its weight of ethylene.

Gas-Minded Leamington Visited by the Midland Association of Gas Engineers

Royal Leamington Spa has for generations been noted throughout England, and far beyond its borders, for its natural beauty and its natural waters, and for our own Industry it has an attraction altogether apart from these. It is gas minded.

In the first place, the whole of the public lighting is by gas, more than 1,200 lamps being in use. The majority are two-mantle square lanterns, with Horstmann clock controllers; but the principal streets have either Keith high-pressure lamps or high-power low-pressure lamps. All the public lamps are maintained by the Leamington Priors Gas Company. In the Pump Room and its associated departments, where the supply of water from a large number of springs, for drinking and bathing purposes, is practically unlimited, and where there are two large swimming baths, both gas and coke are used in the operations involved; and in the treatments the clinical gas lamp has been tried with, it is considered, better results than those obtained by an electric lamp.

In another direction, there is at any rate one hotel—there may be more—whose modern gas installation is noteworthy. This is the Manor House Hotel which was, about eighteen months ago, reorganized, with a group of local business men as Directors. There has been fitted a gas kitchen and still-room equipment, and gas fires in all the bedrooms; while coke is utilized for central heating purposes. An illustrated account of this work, indicating enterprise on the part of both the Hotel proprietors and the Gas Company, will be found on pp. 209-210 of the "GAS JOURNAL" dated July 26, 1933.

THE GAS-WORKS.

These facts were—to use a word dear to the popular Press—"revealed" on Thursday last, when there was a large muster of members of the Midland Association of Gas Engineers and Managers in the town, on the invitation of the Chairman and Directors of the Leamington Priors Gas Company, whose General Manager and Engineer, Mr. R. S. Ramsden, is President of the Association. On assembling at the gas-works, the visitors were greeted by the President, his Chairman (Dr. Harold Mason, J.P.), and Sir J. Ferguson Bell, J.P. (who is a member of the Board). Among the guides during the inspection was the Assistant Engineer and Sub-Manager (Mr. F. A. Jenkins).

Most of the plant on the works is designed for a daily output of 2 million c.ft., while the present annual make is in the neighbourhood of 420 millions. The principal coal store is by the Company's railway siding, about half-a-mile from the works, to which the coal is brought by horse and cart. After numerous trials of other forms of transport, this has been found to be still the most suitable for the purpose. Two-wheeled carts, holding about 30 cwt., are utilized, and the road to the works is somewhat uphill. An interesting point noted in connection with this cartage is that a trial is being made of pneumatic tyres, fitted, of course, to special wheels. This should be a help to the horses, as well as being noiseless; and other advantages which it would be useful to know about may emerge as the result of extended experience.

Coming to the gas-making plant, it may be explained that a horizontal retort house which in parts had been in existence for many years, was replaced in 1928 by an installation comprising a bench of four settings of 40 in. Glover-West vertical retorts arranged in units of fours and settings of eights, making a total of 32 retorts in all, with coal handling plant and a Spencer-Bonecourt waste-heat boiler. All wearing points on the extractor gear are fitted with "Tecalemit" grease gun lubrication, and the lip-bucket conveyor links are lubricated with oil under pressure from automatic gear supplied by West's Gas Improvement Company. In addition to the coal-gas plant, there are two Humphreys & Glasgow carburetted water-gas sets, each of a capacity of half-a-million cubic feet per day. Both are fitted with "Centriflovane" grit catchers. One of the holders has painted on its crown, for the information of air-craft pilots, the name of the town in its officially abbreviated form "Leamntn," together with an indication of the North cardinal point.

A PRESENTATION AT WARWICK CASTLE.

Luncheon, cooked by the all-gas equipment already followed, was provided by the Chairman and Directors of the Gas Company at the Manor House Hotel, and a party of over one hundred sat down to a perfectly prepared meal. Mr. C. M. D. Belton, of Shrewsbury, proposed the toast of "Royal Leamington Spa," and this was replied to by the Mayor, Dr. W. E. Jones, who pointed out that the town was illuminated by gas. Dr. Harold Mason, who presided, next proposed "The Midland Association of Gas Engineers and Managers," to the members of which he extended a very hearty welcome. It was, he remarked, a happy coincidence that the present Engineer, Mr. Ramsden, should be President of the Association during the centenary year of the present Leamington Priors Gas and Coke Company. Records showed that the Gas Company, through its engineers, had always been a strong supporter of the Association. Mr. J. H. Robinson and Mr. W. Cross were both early members. Then, in 1905, the late Mr. Thomas Berridge was President of the Association, and in that year the Association last did the Company the honour of visiting Leamington. Looking at the names of those present on this occasion, it was sad to see how many of the previous visitors were missing. One of the present Directors of the Company, Sir J. Ferguson Bell, was President of the Association in the year 1900. Mr. Ramsden, on behalf of the members, thanked the Chairman for his kind remarks, and assured him that the Association appreciated very much the way in which they had been received. They also appreciated the fact that the Chairman and two of his co-Directors, Sir J. Ferguson Bell and Mr. C. H. Southorn, were with them. It had been a great disappointment to the two other Directors, Dr. F. H. Haynes and Mr. H. G. Hawkes, that they were unable to be present. The President mentioned that among the guests, who included many of the leading men of Leamington, was Mr. H. Rayner, the late Secretary of the Gas Light and Coke Company.

The afternoon was spent in glorious sunshine amid the wonders of Warwick Castle, where the President, on behalf of the members, handed to the Earl of Warwick for his son and heir (aged two days) a silver goblet bearing the following inscription:

Presented to
DAVID ROBIN FRANCIS GUY
by the
Midland Association of Gas Engineers,
May 17, 1934.

This little presentation was a charming thought, and an added pleasure in a day of outstanding success. When the heir is old enough to take notice of the silver goblet, may all those who were present at the ceremony in the Great Hall be still with us to enjoy the memory of this visit to one of England's stateliest homes.

Returning to Warwick, a walk through the celebrated Jephson Gardens, already ablaze with colour, and with fountains sparkling in the sunshine, brought the party to the Pump Room Bathing Establishment, a full inspection of which was permitted. Then there was tea with the Gas Company at the Manor House Hotel, and a sincere and thoroughly well-deserved vote of thanks to the hosts for all they had done for the visitors "on this splendid day"—at the call of Mr. Tomlinson, of Birmingham, seconded by Mr. Arthur Roberts, of Hereford.

In connection with the visit Mr. Ramsden prepared a booklet history of the Leamington gas supply and description of the works, but he fears that copies were not distributed to all the visitors. Any visitor who did not receive one, should address a postcard to Mr. Ramsden, who will be pleased to forward a copy.

Lay-Out and Equipment of a Lighting Research Laboratory

By P. Crawford Sugg, B.Sc. (Eng.), A.C.G.I. (Research Department, William Sugg & Co., Ltd.).

The increased demand for modern street lighting, planned to rigid specifications, has made it essential that the photometric testing of lighting units should be placed on a more exact basis than heretofore. The arrangement of an apparatus which will enable tests to be taken rapidly and yet with a high standard of accuracy is a problem which to-day confronts illuminating engineers.

The general use of reflector wings and refractors on lighting units has had the effect of increasing the effective size of the source; due to this fact two distinct errors are likely to arise unless suitable precautions are taken.

The beam of light from the source to the photo head becomes more or less convergent according to the relative size of the source compared to the distance to the photo head. The inverse square law upon which photometric measurements depend is exactly applicable only to a parallel pencil of rays, and errors will arise if it is applied to a converging ray. The extent of this error has been investigated by various authorities, and it has been found that if the distance from source to the photo head is made at least eight times the width of the source the error is reduced to negligible proportions.

The convergence of the light from the source to the photo head introduces another error in testing which becomes especially important in powerful street lighting units when additional directive reflectors are used. The ray from these reflectors being non-axial might give a maximum candle-power on a photometer head a short distance away at a given angular position of the lamp, and yet in service the ray may be perhaps 15° away from the indicated direction when the light strikes the road 60 ft. or more from the source. A similar error is obviously also liable to occur in the vertical plane.

Accurate determination of both intensity and direction of the light from the source therefore requires the photo head to be as remote from the source as possible consistent with the field intensity in the head being within the most suitable range of values for the instrument and observer.

In addition to these theoretical requirements the apparatus has to be capable of accommodating a large variety of both upright and suspension lamps, and indoor fittings, and rapidity in setting up any of these is essential.

The methods adopted to fulfil these conditions will now be indicated.

General Arrangement.

The lay-out of the laboratory is shown in the accompanying plan (fig. 1). The room available measured 60 ft. by 24 ft. A section 34 ft. by 14 ft. was painted black throughout, roller blinds being used to enable the conversion to a dark room to be rapidly made. Part of the remainder was fitted up as a designing and record office.

The main photometer equipment is located in the dark room, while an 8 ft. cube integrator is in the further end of the room. Other equipment in the lay-out of the room includes a test bar for nipple testing, &c.; calorimeter bench, work bench, vice, and considerable storage space.

The photometer apparatus used for testing is shown in figs. 2, 3, and 5. It consists essentially of lamp mounting and a photo bench, between which is interposed a mirror head adapted to receive light at any angle from the source and direct it axially into the photo head where its intensity is compared with that from a standard lamp in the usual way.

The use of a photo-electric cell for candle-power measurement of gas lamps was carefully considered, but investigation indicated that more consistent results could most readily be obtained using the photometer bench with electric comparison lamp.

Lamp Mountings.

Suspension Lamps.—The lamp under test is arranged with its light centre on the main horizontal axis of the apparatus. Suspension lamps are hung from an arm which may be moved on two vertical guides by rotating a lead screw. The range of movement enables any suspension lamp to be quickly set at the required height. The arm and lamp are counterbalanced to facilitate adjustment. The lamp is locked rigidly on to a rotatable head provided with a protractor (calibrated in degrees 0° to 360°) and an illuminated index. This head turns on ball bearings and is arranged with a spring loaded detent operating in an index plate in which are indents drilled at intervals of 5° around the circumference. The lamp may therefore be located exactly on the angular positions commonly used for testing (0°, 5°, 10°, &c.) with the least possible delay.

The gas connection to the lamp is made through a mercury seal, eliminating any possibility of gas leakage and reducing friction of the rotating parts to a minmum. The seal is designed to stand up to 10 in. of water pressure. A **U** gauge is mounted on the supporting arm and is connected to the supply close above the lamp.

Upright Lamps.—Upright lamps are mounted on a horizontal arm which projects through the side of the mirror head and holds the lamp over the centre of the mirror. This arm slides on a vertical column and is adjustable for height by means of a lead screw and nut. In addition the arm can be rotated through 90° so that it clears the mirrors completely when a suspension lamp is under test, and it can be locked in position with a clamp screw and lever.

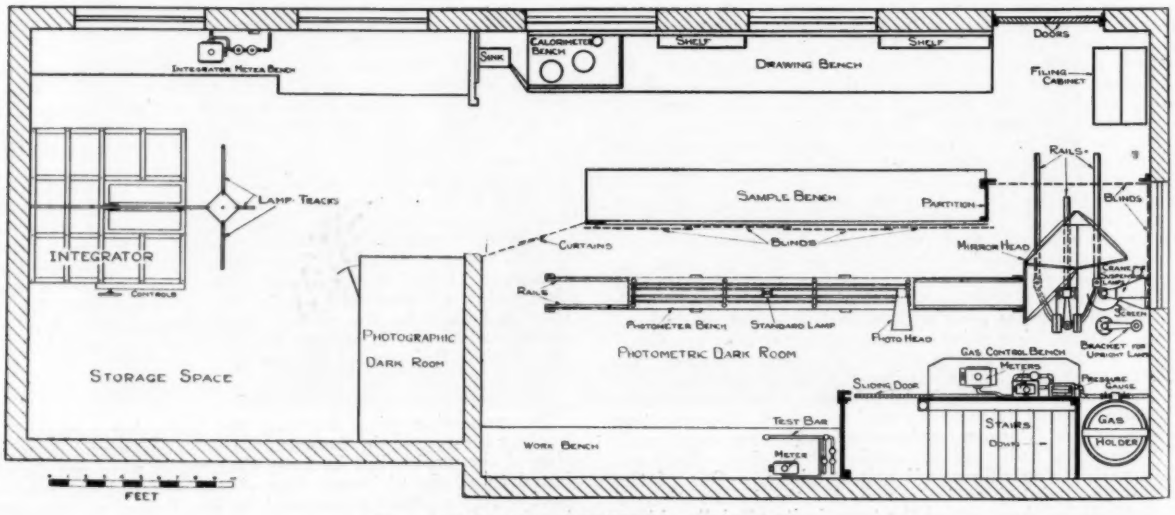


FIG. 1.—PLAN OF PHOTOMETRIC LABORATORY.

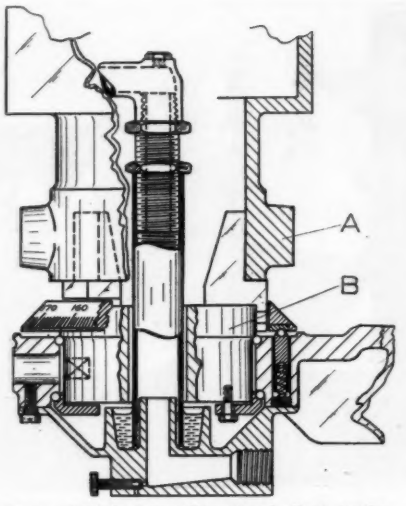


Fig. 4.—Upright Lamp Mounting in Part Section.

The rotating spigot on this arm is shown in fig. 4. The socket (A) of the lamp is gripped internally by a three jaw scroll chuck (B) so that varying sizes of sockets can be accommodated and the risk of eccentric mounting with pinch screws is eliminated. The chuck is rotatably mounted on ball bearings in a ring formed on the end of the arm and carries a protractor with spring loaded detent acting at intervals of 5° in a similar manner to that on the suspension lamp arm.

The gas connection to the lamp is made through a mercury seal formed in the cast-iron bottom cover. A steel tube adjustable for length on a long thread is screwed into the elbow or other connection in the lamp base. The lamp is dropped on to the chuck, set at the correct angular position, and the chuck expanded. The steel tube then enters the mercury to a sufficient depth to withstand about 8 in. water pressure.

The arm is then adjusted for height so as to bring the mantles on the axis of the instrument, locked, and the upper arm lowered on to the top of the lamp to act as a top centre. Square lanterns may more conveniently be clamped on a short length of column held in the chuck, the gas connection being brought out sideways to a rubber hose.

Gas Controls.—The gas supply to the lamp may be obtained from three sources according to the requirements of the test. A small calibrated gasholder with adjustable weights is used for meter checking and consumption tests. Ordinary low pressure is used for candle-power tests; high-pressure gas from a blower below is available for special purposes. The three supplies are arranged with their cocks one above the other on the left-hand side of the control bench, the pipes being distinctly coloured to differentiate them, and the gas may be passed through either of two governor systems and through a 1/12th c.ft., or 1 c.ft. wet gas meter, after which the pressure is measured on a King's gauge; the supply proceeds to a point near the test lamp and is joined to either the suspension or upright lamp arms as required by a length of flexible rubber hose.

Mirror Head.

The mirror head is arranged to move transversely to the main axis of the photometer so that it may be moved clear of the lamp under test, risk of damage to the mirrors during erection of the lamps being thus obviated.

The head is designed to accommodate lighting fittings up to 33 in. diameter and to pass a parallel beam of light of the same size. There are three plane mirrors arranged as shown in fig. 5, the lower ones being perpendicular to each other. The mirrors are all at 45° to the main axis of the instrument, which passes through the trunnion about which they swing. The ribbed cast-iron base frame is mounted on three rails, two of the wheels being adjustable for height. A steel column is spigotted on to the base, and this carries an inclined cantilever arm, at the end of which is the ball-bearing trunnion. This trunnion has a hollow axle, so that during erection sights could be taken along the whole axis of the apparatus and accuracy of alignment ensured.

The mirrors are mounted on felt on a sheet-metal backing stiffened by heavy ribs. These backing sheets are boxed up on a steel plate frame, the whole forming a rigid structure. An outboard bearing on the end of the mirror head remote from the photometer engages with a pin which slides in a bush on a bracket projecting from the lamp crane guides. This pin is engaged with the bearing only when the mirror head is in the operating position and acts as an exact location to the whole apparatus.

When the head is to be moved aside it is rotated down to the lowest position (0°), where it engages a stop block carried on the bed frame; the pin is disengaged and the whole head moved sideways.

To prevent any internal reflection from the sides of the mirror head entering the photometer head adjustable screens are attached to the end of the mirror head. The aperture of the screen is of such a size that only the source can be seen when viewed from the photo head, the sides of the head being cut off. In addition, the interior of the head is painted a matt black colour. These precautions eliminate practically any error due to internal reflection.

The mirror head is completely balanced about its trun-

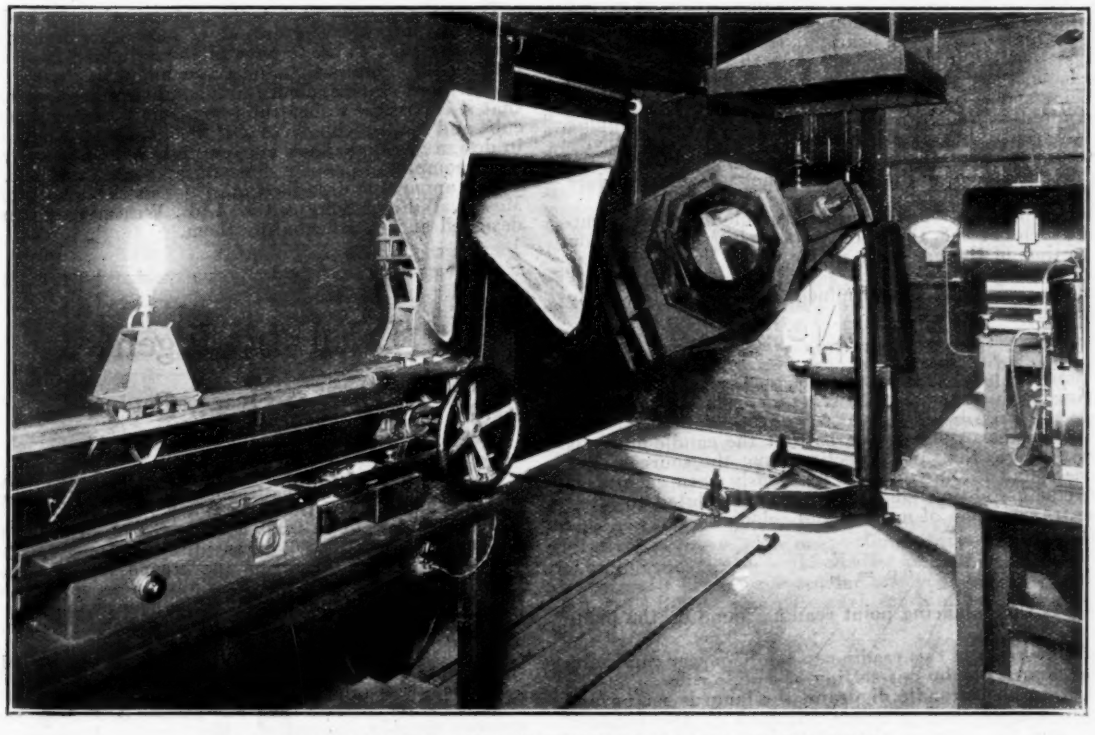


FIG. 2. GENERAL VIEW OF PHOTOMETER BENCH AND MIRROR HEAD.

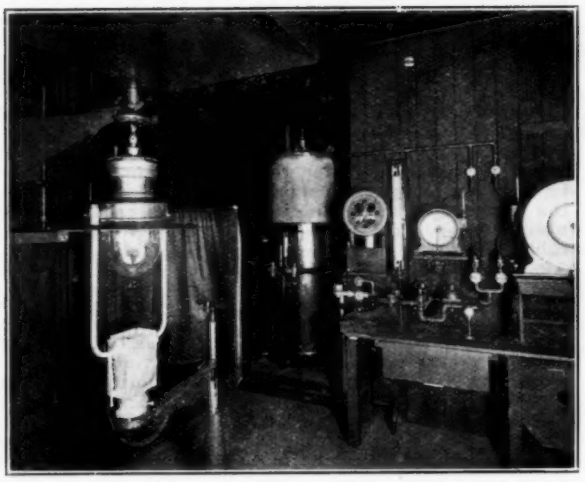


Fig. 3.—Upright Lamp Mounted for Testing (Mirror Head Removed) and Gas Controls.

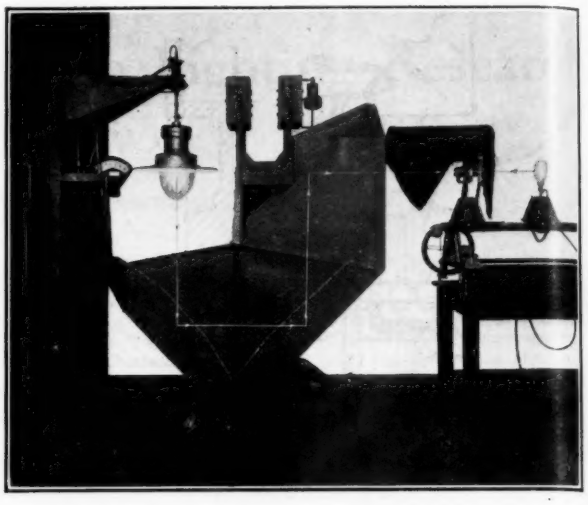


Fig. 5.—Arrangement of Mirror Head, Photometer Bench Run up Close to Mirrors.
(Path of light indicated by solid white line.)

nion by large counterweights attached to the frame, and is controlled by a spring loaded detent which will locate it at intervals of 5°, the angle from vertical being shown on a protractor affixed to the framework which moves under a stationary index.

Photometer Bench.

The photometer bench which is used to measure the light emerging from the mirror head is 15 ft. long and is mounted on rails; it may be locked in several positions, each corresponding to a definite distance between the head and source varying between 12 ft. and 25 ft., including the distance through the mirror head.

The photometer head is of the Lummer-Brodhun contrast type, and is surrounded by a shade which effectively excludes stray light from the operator's eyes. A system of ring screens on the head prevents any light other than that from the mirror head falling on the comparison disc. The electric comparison lamp has a uniplanar filament of nominally 20 c.p., and it is supplied with current through a stabilizing arrangement which smoothes out the very considerable fluctuations in voltage on the mains, due to the proximity of the works. The voltage on the standard lamp is measured at the lamp holder, the instrument being of sub-standard accuracy, and placed in front of the operator.

The truck which carries the comparison lamp is moved on the photo bed by a continuous cord and wheels, the control being under the photo head.

All controls and indications are centralised at the operating position, the distance of the comparison lamp from the head being shown on a steel tape graduated in feet, tenths, and hundredths, which passes under an illuminated index below the centre line of photo head. The operator, therefore, is under no necessity of removing his head from the shade of the screen and his eyes are not affected by glare from the comparison lamp.

To speed up the balancing process a colour screen is employed which corrects the colour of the electric comparison lamp to that of the gas lamp under test. This screen has been previously calibrated by repeated balancing and its transmission accurately determined for the light given by the comparison lamp.

Method of Operation.

The mirror head transmission is obtained by repeated balancing, with and without mirrors, on a lamp of constant output, the lamp being turned 90° and the mirrors raised to 90° when they are inserted, so that the candle-power is always taken in the same direction from the source. The distance round the mirrors has previously been accurately measured by sighting. and a constant calculated to allow for the transmission of mirrors and colour screen.

Then

$$\text{c.p.} = \frac{K}{d^2}$$

where d is the balancing point reading found on the photo head.

The conversion of this reading to candle-power can therefore be carried out by one setting of a slide rule.

In taking an isocandle diagram, the lamp is set up and the consumption and pressure adjusted to the required values, and the lamp is allowed to burn until conditions have become stable. One operator then balances the photo head, while another revolves the lamp and sets the mirror head at each angle and also calculates and records the results. In this way a complete diagram may be taken in a comparatively short time.

Polar curves are obtained by revolving the mirror head round the lamp with the latter set at the required angular position.

Integrating Cube.

The integrating cube (at present in course of construction) in the laboratory is used to measure the total luminous output of a lighting unit and is essential to the development of efficient sources and reflectors.

The cube is built up inside a wooden frame and is painted internally according to the B.S.I. Specification, the lamp to be tested is suspended from a truck running on an I-section beam which passes over the cube. When the lamp has reached its stable condition it is run into the cube through doors in the side and roof, which are closed to make the cube complete.

In testing, the direct light from the source is screened from the opal glass window in the side of the cube. The illumination at this window is measured with a small photometer or photo cell.

The cube is calibrated from a standard lamp of known luminous output. The output of any other lighting unit bears the same ratio to that of the standard lamp as the ratio of the illuminations on the window.

The lamp track includes a turntable and side tracks so that it is possible to heat up two or more lamps outside the cube and make a comparison of their output. Modifications in design are thus much more rapidly tested than by making a complete isocandle diagram and integrating it.

The apparatus described is in use in the laboratories of Messrs. William Sugg & Co., Ltd., Westminster, and was designed and constructed by them.

Legal Intelligence.

Dispute Over a Patent.

Trial to be Held on May 31.

On May 15, in the Chancery Division, Mr. Justice Luxmoore heard an application by the Koppers Company, of Pennsylvania (U.S.A.), and Woodall-Duckham (1920), Ltd., of Victoria Street, S.W., for a date to be fixed for the trial of an action for the revocation of patent 366,656 granted to Norman James Bowater and Arthur Henry Lymn, on the ground that the invention named was wholly anticipated by disclosures in prior specifications, and that the nature of or the manner in which it was to be performed was not sufficiently and clearly described and ascertained in the complete specification.

Gas Chambers and Coke Ovens, Ltd., were also stated to be respondents in the action.

The case was said to be an appeal from a decision of the Comptroller of Patents, and the parties desired to have the question speedily disposed of. His Lordship fixed the hearing for May 31 next.

Wales and Monmouthshire Association of Gas Engineers and Managers

ANNUAL MEETING IN CARDIFF

The twenty-ninth annual meeting of the Wales and Monmouthshire Association of Gas Engineers and Managers was held on Thursday, May 17, in the Lecture Hall of the South Wales Institute of Engineers, Cardiff—Mr. IFOR G. JENKINS (Abertillery), the President, in the chair.

The minutes of the previous annual meeting having been read by the HON. SECRETARY (Mr. Octavius Thomas), the PRESIDENT referred to the loss the Association had sustained in the death of Mr. Collin, of Bridgend, and the members stood for a moment as a mark of respect.

Reference was then made from the Chair to the presence of Mr. Frank P. Tarratt, President of the Institution of Gas Engineers; Col. S. S. Ogilvie, Joint Manager of the National Gas Council; Mr. F. G. Brockway, President of the Eastern Counties Gas Managers' Association; and Mr. J. H. Cornish, Past-President of the Southern Association, and a hearty welcome was given to each of these gentlemen on behalf of the members.

THE ASSOCIATION ROLL.

On the motion of Mr. B. J. BELL, seconded by Mr. A. E. WILLIAMS, the following new Members and Associates were elected to the Association:

NEW MEMBERS.

W. T. Kenshole, Engineer and Manager, Merthyr Tydfil Gas Company.
K. H. H. Langford, Cardiff Gas Light and Coke Company.
H. Maycock, Engineer, Manager, and Secretary, Abertillery Gas Department.
W. Jones, Cardiff Gas Light and Coke Company.

TRANSFERRED FROM STUDENT TO MEMBER.

R. W. Broadhead.

ASSOCIATES.

J. S. Burgoyne, Carshalton Beeches.
F. Fennemore, Wellington.
G. Sawyer, Kenilworth.
A. E. Jones.

ANNUAL REPORT.

The 29th Annual Report showed that during the year five members and 11 associates joined the Association, while one student was transferred to member. Two members died, one member and one student resigned, leaving the total strength of the Association at the end of the year as 72 members, four hon. members, four students, and 46 associates. The receipts for the year amounted to £122 5s., and the payments to £111 14s. 9d, leaving with the balance brought forward the sum of £28 14s. 10d. in the hands of the Treasurer with 2½% Consols.

On the motion of Mr. D. MUIR (Pontypridd), seconded by Mr. J. MOGFORD, the report and statement of accounts were adopted.

NEW OFFICERS.

The following officers for the ensuing year were then elected:

President.—Mr. H. Barker (Llanelly).
Vice-President.—Mr. H. Matterface (Monmouth).
New Members of Council.—Mr. H. G. Howard (Bridgend) and Mr. F. Dupont (Brecon).
Treasurer.—Mr. J. H. Canning (Newport.)
Hon. Secretary.—Mr. Octavius Thomas (Pentre).
Auditors.—Mr. J. Robb and Mr. J. F. Rust.

Mr. J. E. KENSHOLE, proposing the election of Mr. Barker, congratulated the Secretary and members of the Council upon their success in prevailing upon Mr. Barker to accept the office of President. The honour was long overdue, and he felt sure that Mr. Barker would make an excellent President.

Mr. H. MATTERFACE seconded the resolution, which was carried unanimously.

Mr. BARKER said it was with mixed feelings that he accepted the high honour conferred upon him, as he had not been able to support the Association by his presence at meetings as often as he would have liked. However, he would do his best to carry on the good work, and try to follow in the footsteps of those who had gone before him. To those golfing members of the Association who were present he remarked that he would welcome the opportunity in a year's time of arranging a visit to the links at Ashburnham.

Mr. T. WILKINSON (Abercarn) proposed, and Mr. W. C. JACKSON (Neath) seconded, the election of Mr. H. Matterface (Monmouth) as Junior Vice-President.

In moving the re-election of the Hon. Secretary, the PRESIDENT paid tribute to the work Mr. Octavius Thomas had done for the Association. Referring to the Secretary's recent retirement from active service in the Rhondda Valley, he wished him long life to enjoy the leisure which he had so well earned. He felt sure the members were glad to learn that the Council were not going to lose Mr. Thomas's services.

Mr. H. D. MADDEN (Cardiff) joined in the tribute, remarking that he was glad Mr. Thomas's retirement would give him more time to work for the Association. He hoped their Secretary would be spared to carry on his duties for many years to come.

The HON. SECRETARY moved that £10 10s. be subscribed to the Benevolent Fund of the Institution of Gas Engineers; also that £2 2s. be given to the Sir Arthur Duckham Memorial Fund.

Mr. J. H. CANNING, in seconding, expressed the hope that individual members would subscribe what they could afford to the Benevolent Fund of the Institution, which was doing very noble work. The motion was unanimously agreed to.

LONGER REPRESENTATION ON INSTITUTION COUNCIL.

Mr. J. H. CANNING then moved the following resolution:

> That each District Member of the Council of the Institution of Gas Engineers, appointed by us as an affiliated District Association under By-law 53, should continue in office for three years, such representative not necessarily being the President of the Association.

It had been the custom, he said, to appoint the President to the Council for one year. They had had many able representatives under that rule, but he must say, and he had spoken to several Past-Presidents, that it had been their experience that just as they were beginning to get a thorough grasp of the Council work others came along and took their place. District representatives were appointed for the benefit of the Council and of the Institution, and they should be well acquainted with the needs and requirements of the districts. Therefore, he felt that it was imperative that they should have a longer term of representation. Another reason why they should adopt the three years' system was that with regard to numbers and voting power they were one of the weakest Districts. There were Districts which had three or four times their voting power, and therefore had a better chance of electing representatives on the Institution Council. In view of that fact they should have more permanent representation on the Council than they had at present. He would like to add to the resolution that the Council recommended the election of Mr. Octavius Thomas as their first representative under the new rule. While this was, of course, a tribute to the esteem and affection with which they regarded their Secretary, there was another reason why they should do him this honour, and that was because Mr. Thomas would be the best representative they could have.

Mr. H. D. MADDEN, in seconding the resolution, said this policy was a very wise one. Continuity was necessary, and a representative could not be of real service to the Institution if he was elected for one year only. He could not learn all that was necessary for him to learn in that time.

Mr. J. H. CORNISH (Southern Association) said he thought this was a very wise procedure, and if he had the opportunity he would try to get his own Association to adopt it.

The resolution was unanimously adopted, and the Hon. Secretary made suitable acknowledgment.

Luncheon.

Following the meeting a luncheon was held at the Park Hotel.

In the course of the proceedings Mr. L. G. Williams (Chairman of the Cardiff Gas Light and Coke Company) presented Col. O. B. F. Planck with the Association's Championship Golf Cup, which he won for the second time in the open competition at Penarth on May 16.

The toast of "The Wales and Monmouthshire Association of Gas Engineers and Managers" was given by Mr. Frank P. Tarratt, who congratulated the Council and members on the success of their meeting.

The President, responding, said the discussions and papers read from time to time helped them greatly in their work. The future of the Gas Industry depended almost entirely upon their efficiency and service to the consumers. "We are particularly fortunate in having Mr. Thomas as our Secretary," he said. "It is almost impossible for me to give adequate expression to our appreciation of his valuable services, not only to our Association but to the Gas Industry generally."

"Kindred Societies" was given by Mr. J. H. Canning. Coupling with the toast the name of Capt. Carey, Mr. Canning said his scheme for the drainage of the Welsh coalfield should have the careful consideration of all the industries concerned.

Capt. J. Macleod Carey, O.B.E. (President of the South Wales Institute of Engineers), responding, said the Gas Industry was undoubtedly coming into its own, and coal would benefit.

Mr. Ewart R. Evans (General Manager, South Wales Coal Distributors, Ltd.), who also responded, said the Gas Industry in South Wales was particularly fortunate in having such able representatives at its head. The coal industry did not fear the competition of the Gas Industry, and he had never heard any responsible person in the coal industry express concern at its progress, which, he hoped, would be even greater in the future. The two industries were interdependent.

Visit to Grangetown Works.

Afterwards the members visited the Grangetown Works of the Cardiff Gas Light and Coke Company, by whom they were entertained to tea.

A DAY'S GOLF AT PENARTH.

The Glamorganshire Golf Club generously placed their premises and excellent links at the disposal of the Association on the day preceding the meeting; and there was a good entry for the Upjohn Cup, played for by Medal Round over 18 holes. The leading returns were as follows:

Col. O. B. Planck	83–10=73
C. R. Averill	86–13=73
H. Matterface	99–21=78
F. D. Drake	98–20=78
W. C. Jackson	83– 4=79
R. R. Bird	89– 9=80
E. S. Allen	92–12=80
F. Boardman	97–17=80
J. Sadler	97–16=81

The results of Bogey Foursomes in the afternoon were:

H. Matterface and H. E. Bennett	6 down
C. A. King and F. D. Drake	7 down
R. J. Auckland and R. R. Bird	7 down
W. C. Jackson and T. B. Walker	7 down
C. L. Bury and F. Boardman	8 down

The arrangements for the golf were ably carried out by Mr. Joe Sadler.

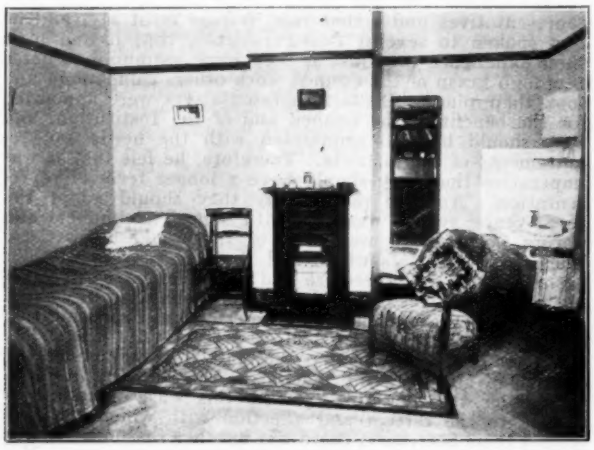
In the evening the usual Dinner took place at the Esplanade Hotel, Penarth; Mr. R. J. Auckland in the Chair. According to custom highly commended, there were, after the Loyal Toast, only two others—to Mr. Octavius Thomas (loudly acclaimed) and to Mr. H. H. Hammond, Secretary of the Golf Club. Then Mr. J. H. Canning presented the prizes to Colonel Planck and Messrs. Averill, Bennett, and Matterface, all of whom generously returned their Sweepstake winnings for the benefit of the Benevolent Fund of the Institution.

The visitors to Penarth had been made Honorary Members of the Penarth Yacht Club, one of whose Committee is Mr. H. D. Madden; and many availed themselves of this hospitality.

Gas Plays Large Part in Sheffield University Ladies' Hostel

There was recently opened in Endcliffe Vale Road, Broomhill, Sheffield, a University Ladies' Hostel.

The extensive new building additions are chiefly used for the resident University lady students. In this section are 62 new bedrooms, on the model of the one shown in the accompanying photograph, and each of these is heated exclusively by means of the built-in type gas fire mantel with seven radiants. It is noteworthy that when the architect responsible was designing the chimney breasts he



Example of Bedroom in Sheffield University Ladies' Hostel.

was able to give six ventilating flues (three on each side of the partition walls) in less space than that usually required for two ordinary coal fires. These flues are 5 in. square inside and have proved highly satisfactory.

In the old portion of the building there are a further eight bedrooms, each fitted with gas fires of sizes suitable to the dimensions of the rooms, and each fire in the old and new sections is fitted with a safety guard.

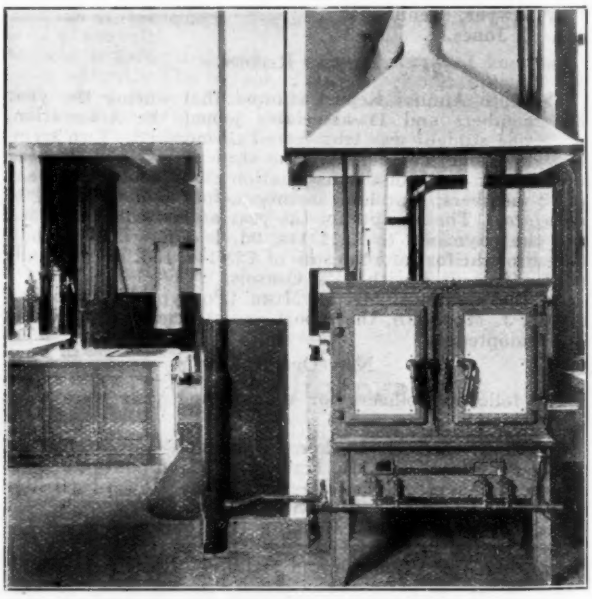
The following gas appliances have been installed in the new kitchen, which is also illustrated:

One double-oven gas range in blue-grey enamel finish.

One carving table and hotcloset in blue-grey enamel finish, complete with white enamelled sliding doors.

One double gas steamer in blue-grey enamel finish, with white enamelled doors, fitted on stand.

Two water-jacketed vegetable boilers in blue-grey enamel finish.



A General View of the Kitchen attached to the Ladies' Hostel.

Instantaneous boiling water is obtained from a gas-heated automatic boiler.

A special feature of this kitchen is the composition hoods and ventilating pipes, the condensation trouble generally associated with the use of metal hoods and pipes being entirely eliminated and adequate ventilation being assured. It is also of interest that in this installation approximately 1,200 ft. of gas piping was used.

Steaming of the Free Space in Horizontal Retorts

By the Engineer and Works Technical Staff of the Cardiff Gas Light and Coke Company.

[A Paper before the Wales and Monmouthshire Association of Gas Engineers and Managers at Cardiff, May 17, 1934]

PREAMBLE.

By H. D. Madden.

Towards the end of the war, approximately early in 1918, when the oil supplies of this country were at a low ebb, the late Mr. W. Doig Gibb, who was then assisting Lord Moulton at the Ministry of Munitions, asked me to consider if anything could be done to obtain more oils from coal tar in gas-works practice.

At that time the majority of gas-works were using the 6-cwt. charge, with a carbonizing period of six hours, and high heats were beginning to be widely adopted. The majority of the retort stoking machinery was of a type that did not cater for heavy charges and/or filled retorts.

The retort house stoking machinery at the Grangetown (Cardiff) Works comprised West's compressed air-driven rakes and scoop machines, which laid medium light charges of coal in the retort, and consideration was first given to the question of the effect of the free space—*i.e.*, between the charge and the heated crown of the retort—and the nascent tars and gases.

It was common knowledge that degradation of the nascent gases occurred through contact at this point, as evinced by the carbon formation on the retort crowns, dust in the ascension pipes, and the presence of free carbon and high water content in the tar.

Consideration was given to these factors, and the question as to how this contact could be avoided and the degradation process reduced considerably or entirely eliminated. It was ultimately decided that if a stratum of steam could be introduced in such a manner that it travelled along the length of the crown of the retorts and shielded the nascent hydrocarbons from the hot surface of the retort, a tar of a superior quality and containing a higher oil content with a low free carbon percentage might be produced.

No. 2 retort house at the Grangetown Works was therefore fitted with steam pipes and a supply of steam fitted to each retort mouthpiece. This house contained 40 beds of 20-ft. through horizontal retorts.

Owing to the depletion of staff through Army requirements, no proper facilities for complete investigation were available, and, the war ending shortly afterwards, this question was relegated to the limbo of past causes while we were so busy reconditioning the works after the four years of war.

Creosote Oil for Admiralty Purposes.

A year or two ago, while I was serving as a member of the Fuel Research Board, the question of oil from coal and the use of creosote oil for Admiralty purposes came under review. Tests were carried out and some difficulties were found in using ordinary creosote distilled from tar, such as the presence of naphthalene which stopped the burner jets and other factors.

The facts relating to the 1918 investigation—viz., that of introducing steam in the free space of horizontal retorts—was again introduced, and the Director of Research, Dr. Sinnatt, was requested to test out this suggestion in the horizontal retort setting at the Fuel Research Station at East Greenwich. The first results obtained showed that the thermal gaseous production had considerably increased, without incurring any additional fuel charges in the heating of the setting, and Dr. Sinnatt reported the following results in the William Young Memorial Lecture, 1933:

Yield of gas expressed in therms per ton of coal was having a calorific value of	84·5 528 B.Th.U.
The average yield without the introduction of steam was of gas having a calorific value of	75 therms 550 B.Th.U.

This question—viz., steaming of the free space—is one entirely apart from steaming the charge of incandescent coke, where steam is made to pass through the mass of the charge itself, and the water gas reaction occurs—viz., $H_2O + C = H_2 + CO$—by the decomposition of the steam and chemical reaction with the carbon of the coke.

Apart from the fact that interesting chemical and physical problems occur in the steaming of the free space, the resulting action produces more therms per ton of coal carbonized, which is a financial aspect, and brings the efficiency of horizontal carbonizing to a higher commercial value.

Concurrent with the investigations at the East Greenwich Station, we resumed our operations at Cardiff in No. 2 retort house, supplemented by research on the coal test plant there, which contains stop-ended retorts.

The carbonizing and chemical staffs of the Company present their experiences and results in the examination of this question, together with the additional experiences of "Arca" control governing in retort house practice.

ENGINEERING AND CHEMICAL STAFF INVESTIGATIONS AND OBSERVATIONS

By F. Boardman, J. Harold Williams, and L. L. Kleist.

The question of steaming the free space in the horizontal retorts has been a study of our Chief, Mr. H. D. Madden, for some time. Recently he re-opened the question and directed us to investigate the matter further.

For the purpose of our investigation, it was decided that whatever results and data were obtained from our observations should be obtained with retorts in sound and good condition. With this object in view, seven beds of horizontal retorts, which had been recently re-set, were put under fire.

The settings consist of eight retorts, each 20 ft. long, and having a section of 22 in. by 16 in., each retort having a 6-in. diameter ascension pipe at each end. The retorts are charged with a Fiddes Aldridge combined charging and discharging machine.

With this type of machine, it was necessary to determine the best place to admit the steam to the retorts. It was impossible to fix an elbow to the mouthpiece pointing in such a way as to throw a jet of steam horizontally through the retort owing to possible interference with the head of the charging machine, also the hot coke might possibly cause a choke, and, in many cases, the jets would be knocked off.

It was therefore decided to drill the retort mouthpieces at the discharging end of the retort, at a point near the top, to receive a $\frac{3}{8}$-in. nipple, reduced to give a $\frac{1}{4}$-in. steam orifice. All the mouthpieces were drilled *in situ*. This entailed considerable trouble owing to the restriction of space between the mouthpieces.

It was fortunate that a 6-in. steam main existed in close proximity to the retorts and, therefore, only a short length of steam service pipe was necessary. At a point near the beds, the main steam pipe was tapped to receive a 2-in. steam service pipe.

As it was necessary to know the quantity of steam being admitted to the retorts, also to break down the steam pressure from 80 lbs. per sq. in. to 25 lbs. per sq. in., the steam pipe was provided with a steam trap, reducing valve, pressure gauge, and steam meter of the Kent low-pressure type.

The service pipe was carried along the top of the retort bench with a view to keeping the pipe warm and so reducing condensation. Each bed had a branch service from this, and connections were made to each retort with a cock for regulating the steam per retort. A "blow-off" cock was also provided to every bed to remove any condensation. All steam pipes were well lagged right up to the point of admission at the mouthpiece.

It was realized at the commencement that any success to be obtained as a result of our investigations could only be achieved by the use of as high a temperature steam as possible. Before steaming commenced, it was necessary to close up the ascension pipe on the discharging end of the retorts. This was done by inserting 6-in. firebrick plugs in the pipes and sealing with fireclay. Within a very short time the plugs became absolutely gas-tight by the accumulation of tar and pitch.

Working with one ascension pipe only, it followed that an increase in vacuum was necessary to ensure the easy removal of the gases.

All the coal carbonized was obtained from the Welsh coalfield. The machines laid an average charge of 9 cwt., which was carbonized for 8 hours, this quantity of coal giving a free space in the retort of approximately 45%.

Early Experience.

Our first attempts at steaming the free space of the retorts were made with wet steam, which had a temperature at the point of admission of only 103° C. The procedure in the first place was to allow a plug of coke about 3 ft. long from the previous charge to remain in the retort and

against the mouthpiece door on the discharging side. Although this of necessity lowered the throughput of the retort, its object was to compensate for any losses that might occur due to excessive cooling at this end of the retort owing to the introduction of the wet steam. From our observations under these conditions, it was found that, by introducing steam during the last two hours of the carbonizing period at the rate of 2% by weight per hour of the charge (which is equivalent to 20 lbs. of steam per retort per hour) and at a working pressure of 25 lbs. per sq. in., there was a decrease of temperature in the front of the retort. This decrease occurred over the first few feet of the retort at the steaming end, and ranged from 50° to 60° C., the temperature being lowered from 1090° to 1040° C., and about 3 ft. of the charge was incompletely carbonized.

The reduction in temperature was not so apparent throughout the whole length of the retort, but was most marked for the first 2 ft. Here, condensation took place rather heavily and became most noticeable when the mouthpiece doors were opened.

A reduction in temperature, of course, had been anticipated as a result of the use of wet steam, but, there being no means of superheating the steam at that period of the observations, opportunity was taken of observing the maximum cooling and other effects likely to be met with. It may be stated here that it was also observed that, with our type of charging machine, by leaving a small portion of the old charge in the retort, there was a tendency to drag back the charge. This difficulty would not occur where a charger of the impeller type was in use.

At this stage steaming was discontinued until such time as superheated steam was available.

After giving consideration to several methods of superheating the steam, it was found that, in our case, the most convenient arrangement, but nevertheless a most uneconomical one, would be the utilization of an adjacent setting which at the time was not required for carbonization purposes. The retorts in this setting were therefore used as a means of heating the steam.

A 2-in. pipe was passed through one retort and back through the next, until finally each of the eight retorts had a length of pipe running through it. This gave a total length of about 160 ft. of pipe for superheating the steam. The superheating was carried out immediately after metering.

Temperatures were regulated in this bed to supply steam to the retorts at a temperature of 280° C. at the point of entry. To obtain this degree of superheating, it was only necessary to maintain the retorts at a dull red heat and to close the ends loosely with firebricks.

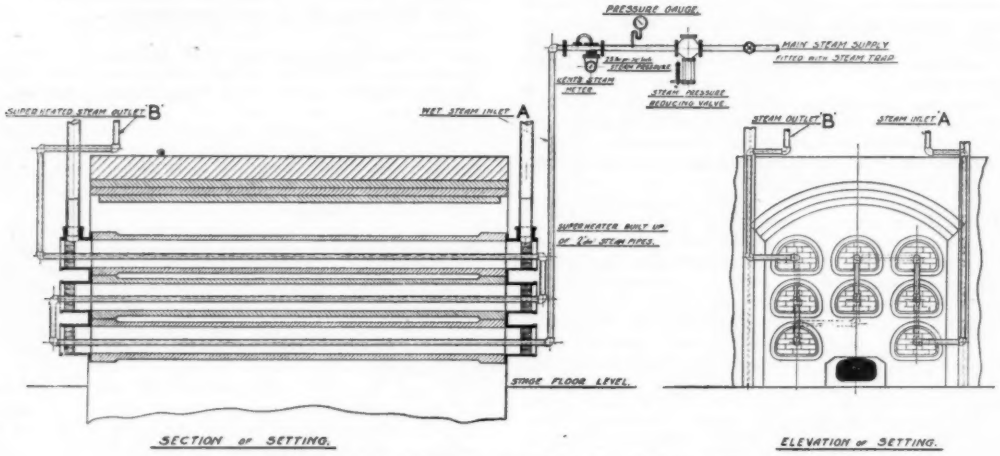
Under these improved conditions, steaming was then carried out for the last hour of the carbonizing period, and subsequently the steaming period was gradually increased by 15-minute stages until a two-hour period had been reached.

Up to this point steaming had been carried out without any noticeable drop in temperature. When steaming for more than two hours cooling was noticeable, and it was therefore concluded that two hours was the maximum period during which steaming could be successfully carried out. It might here be stated that up to the maximum of two hours' steaming all charges appeared to be completely carbonized, and this period of two hours was assumed, in our case, to be the utmost limit to which most South Wales coals nascent tars and gases could be steamed. In particular, great care had to be taken with certain slowly carbonizing coals.

For all periods, steaming was maintained at the same rate—*i.e.*, 2% by weight per hour of the charge, or 20 lbs. per retort per hour at a pressure of 25 lbs. per sq. in. The combustion chamber temperatures from 1,250° to 1,280° C. were maintained throughout without any increase in the amount of coke used in the producers. Retort temperatures averaged 1,050° C.

An increase in the number of stopped pipes was noticed, but this was confined to the top retorts only, where the ascension pipes were shorter. The deposit was soft and easily removed. This increase was undoubtedly due to the higher temperatures prevailing as a result of all the gas passing in one direction. Hydraulic mains worked freely, but greater oscillation than usual was observed, accounted for by the increased volume of gas entering one main.

During the periodic "run-offs" of the hydraulic mains, it was noted that the heavy tars were hotter, and consequently ran more freely. The increase in temperature, compared with that of normal working, was 10° to 15° C. Average samples of the tar collecting in the hydraulic mains of the seven beds working under the new steaming arrangement, and others taken from seven beds not subject to the steaming arrangements but otherwise working under identical conditions, were tested with the following results:



DIAGRAMMATIC SKETCH SHOWING METHOD OF SUPERHEATING STEAM.

TABLE I.

—	Sample from Beds not Subjected to Steaming Arrangement.		Sample from Beds Subjected to Steaming Arrangement.	
Sp. gr. . . .	1·209		1·233	
Water content .	2·5%		2·9%	
Distillation.	% by Volume.	Liquid At.	% by Volume.	Liquid At.
		°C.		°C.
0 to 200 . .	2·0 liquid	..	1·4 semi-solid	16
200 ,, 240 . .	10·0 solid	48	8·0 solid	51
240 ,, 280 . .	8·4 solid	48	6·8 solid	52
280 ,, 320 . .	4·8 semi-solid	37	4·0 solid	43
320 ,, 360 . .	10·8 solid	60	11·2 solid	60
Pitch (by diff.)	64·0		68·6	
Free carbon .	18·7 by weight		26·1 by weight	

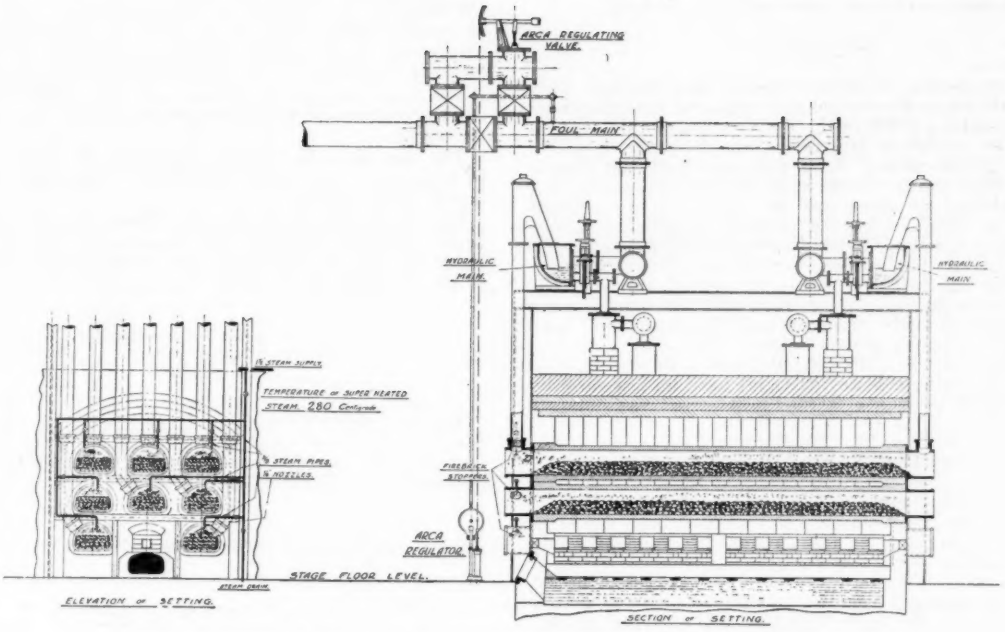
A sample of tar taken from one bed without steaming, but with the ascension pipe on one side closed as for steaming, gave a free carbon figure of 28·0%, thus showing that a portion of the increase of the free carbon content was due to the longer travel of the gases in the retort. A slight increase in density and free carbon was also found in the works stock of tar.

Upon comparing steamed retorts with non-steamed retorts during the last hour of carbonization, there was a noticeable increase in the volume of gas on removal of the plugs on the bridge pipes.

Many samples of the crude gases were taken from the bridge pipes of retorts situated in the various positions of the beds, and at periods either immediately before or during steaming, for analysis during the investigations.

Although the results varied with coals, conditions, &c., the general tendency of the results was maintained throughout, and has led us to the following conclusions.

It was found that in the case of the centre retorts, which are the hottest, practically all unsaturated hydrocarbons



SECTION THROUGH HORIZONTAL RETORTS SHOWING METHOD OF STEAMING.

had been evolved at the time steam was introduced, and the introduction of steam to these retorts produced, to a certain extent, the water gas reaction. Carbon dioxide increased slightly, together with a greater increase of carbon monoxide.

In the case of side retorts where the temperature was slightly lower, and where carbonization had not proceeded so far at the time steam was introduced, the effect of the water gas reaction was not quite so pronounced; also, at this time the gas being evolved from these retorts contained 1·5% of unsaturated hydrocarbons.

On the introduction of steam for the last two hours it was found that some unsaturated hydrocarbons were present in the gases taken from the bridge pipes of these retorts practically right up to the time of re-charging, but when these retorts were not steamed the percentage of unsaturated hydrocarbons present in the gas at the same point and same time was of a lower order. This indicates that, although the unsaturated hydrocarbons are undoubtedly still being produced in the retort without steaming, they are partly lost to the gas yield due to receiving excessive cracking with the formation of scurf in their passage along the retort to the collecting mains.

There appears to be some protection afforded these hydrocarbons by the steam in the free space, as is again indicated by the fact that there was practically no scurf formation on the steaming end of the retorts.

Another effect noticed was that, in the case of newly scurfed retorts, which, of course, would not have reached their maximum tightness, and where nitrogen and carbon dioxide from flue gases find their way into the retort, the increased pressure or blanketing of the steam admitted had the effect of depressing these inerts as was shown by comparative analysis.

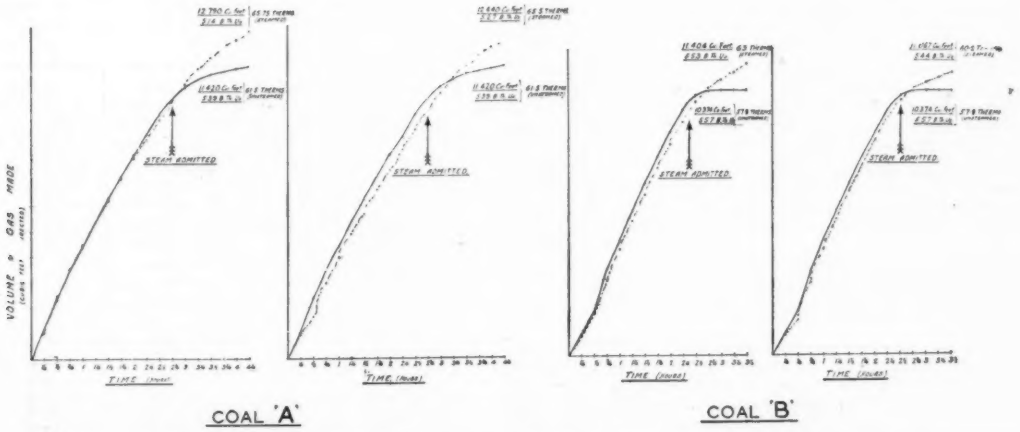
Calorific Value of the Gas.

It was thought that it would be useful if calorific values of the gas could readily be taken from the ascension pipes during the end period of carbonization and steaming. Samples of gases from the ascension pipes were therefore drawn into a large glass aspirator and purified during their passage to a collecting vessel. Calorific values were taken, which were only approximate, but at the same time comparative, by means of a small portable calorimeter.

From the results obtained, a somewhat lower calorific value was invariably found on the steamed retorts compared with the non-steamed retorts. It was found that this difference varied between 20 to 40 B.Th.U., but, as previously stated, there was a much greater volume of this low-grade gas being evolved, as compared with normal working.

No difference had been noted in the composition of the mixed coal gas, and the usual sulphur compounds figure of 20-25 grains per 100 c.ft. obtained on this stream was maintained. Cyanogen, too, varied between the usual limits.

No difficulty was experienced by having to work with a higher and more closely controlled vacuum necessitated by removing the gas from one side of the bench only. The



COAL 'A' COAL 'B'

GRAPHS SHOWING THERMS MADE PER TON OF COAL WITH AND WITHOUT STEAMING.

Arca regulator used in conjunction with the regulating governor valve gave a very easy and even control.

Scurfing.

The accumulation of retort carbon was watched very closely, and after a time it became apparent that a decided change was taking place in the distribution of this deposit. Instead of being evenly deposited throughout the length of the crown of the retort, there was practically no deposition after two months' working on the steaming side, but on the charging end there was an increase in the amount deposited as compared with normal working. Unfortunately, this shows that the working period of the retorts between scurfing had not been extended. Some improvement in this direction had been anticipated, but this was not so. One improvement found was that the retort carbon could be more quickly removed and the retort put back into action in a much shorter space of time.

The nature of the scurf varied from a flocculent type nearer the steaming side to the usual hard and close grain type typical of horizontal retort practice at the opposite end.

Coal Testing Plant.

At the commencement of the experiments the authors appreciated how unsatisfactory it was that they would be unable to give any definite data in regard to yields, calorific value, &c., owing to the fact that the experiments would be confined to one section only of the horizontal retort house, and that the stream from this house was common to a quantity of gas being evolved in the vertical retort house.

For this reason it was decided to try steaming on the stop-end retorts of the coal testing plant, for here definite conditions of carbonization could be more or less regulated and repeated, and measurements made of gas, tar, and liquid yields, calorific value, &c., as well as variation in the timing and conditions of steaming.

It should be pointed out that no suggestion is here being made in advocating the steaming of stop-end retorts in the manner in which this was carried out by the writers. The method was pursued solely for the purpose of obtaining information and guidance which otherwise would not be available.

The retorts on the test plant are three D section, each 14 in. by 10 in. by 7 ft. 7 in. long, and each retort can normally completely carbonize 1 cwt. of coal in 3-4 hours.

The free space in this case, neglecting any swelling of the coal which might take place during carbonization, was at least 60% of the retort capacity.

The lids were drilled and tapped so that 8-ft. lengths of $\frac{3}{8}$-in. steam pipe could be quickly inserted at any time during the working of the charge. Two $\frac{1}{8}$-in. holes at the end of the pipe delivered steam in the free space at the far end of the charge, thus giving a travel of about 7 ft. of heated surface. Owing to this short length of travel it seems quite reasonable to assume that any increased yields obtained would be considerably increased when applied to the large plant.

The steam entered the retorts in a wet condition at about 20 lbs. per sq. in., but its passage through the heated pipe assured its reaching the retort surface in a highly superheated state.

Working with a typical sample of good gas-making coal (Welsh), it was found to be completely carbonized in 4½ hours, giving yields as in Table 2. Repeat tests were afterwards made under varying conditions of steaming, and the comparative results are indicated in Table 2.

The total amount of steam used was calculated by condensing externally for short periods before and after, and averaging.

The procedure in working the hydraulic main was to fill to overflow at the weir valve before charging, no further liquid being added.

The formation of liquor practically ceased after three hours' working, so that any increase in the quantity of liquor formation during the steaming period was a guide to the quantity of steam not decomposed.

		%
The analysis of coal gave :	Volatile matter	26·4
	Ash	9·0
	Sulphur	0·54

The first point to be noted in the foregoing comparative figures is the fact that a mid-steaming period shows no increase over normal working; in fact, the increase in liquor yields indicated that the temperature and conditions

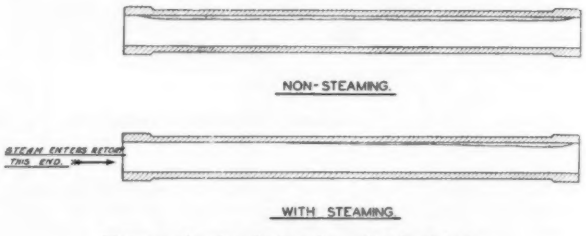


Diagram Showing Carbon Formation in Retorts.

prevailing in the retorts at that period are unsuitable for decomposition of the steam.

The gas yields show a definite increase of an average of 1,400 c.ft. per ton with an average drop in calorific value of 25 B.Th.U.

The increase in therms per ton is fairly consistent throughout the tests, reaching a maximum of 5·6 therms.

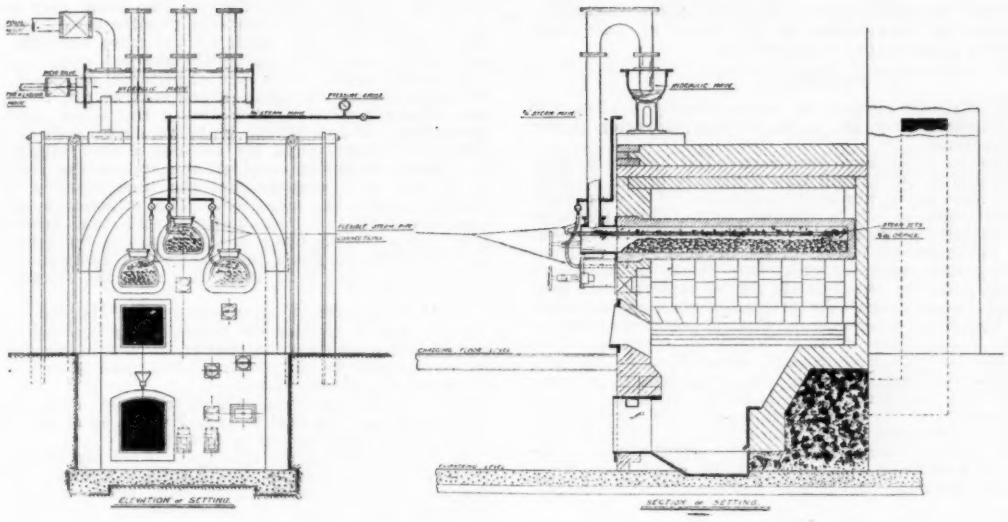
The coke was unchanged in appearance, and the yield was the same in both cases. The decrease in tar yield is difficult to explain, but seems to confirm the thickening experienced on the large plant, but not for the same reason.

It might be mentioned that level-gauge conditions in ascension pipes were maintained throughout, and gas yields determined for every quarter of an hour of the charge. The increase in volume during the steaming period varied between 50 and 100%.

As all gas was evolved after 4½ hours without steaming, the process was carried no further with steaming, although appreciable quantities of gas were still being produced (approximately 100-150 c.ft. of gas per ton per quarter of an hour).

Table II

—	Without Steaming.	Steaming.			
Carbonizing temperature	1,110° C.	1,090° C.	1,090° C.	1,110° C.	1,090° C.
Period of carbonization	4½ hrs.	4½ hrs.	4½ hrs.	4½ hrs.	4½ hrs.
Steaming period	..	Last 1½ hrs.	Last 1½ hrs.	Last 1½ hrs.	Middle 1½ hrs.
Total steam used	..	?	9·6 lbs.	9·1 lbs.	7·8 lbs.
% steam	..	?	4·3	4·0	3·5
Gas per ton (corrected)	11,420	12,440	12,790	13,210	11,790
Calorific value	539	527	514	508	522
Therms per ton	61·5	65·5	65·75	67·1	61·5
Increase in therms	..	4·0	4·25	5·6	*Nil*
	Cwt. Qr. Lbs.	Cwt. Qr. Lbs.			
Coke per ton (dry)	12 3 14	12 1 24			
Breeze per ton (dry)	2 26	3 13			
Tar—gallons per ton	12·5	?	10·25	10	?
Liquor—gallons per ton	16	18	17·9	19·5	22·1
Sulphur compounds (grains per 100 c.ft.)	13·7	10·2	?	?	?
Gas analysis—					
CO_2	2·4	2·5	2·8	3·2	3·0
O_2	0·8	0·5	0·6	0·7	0·6
Unsaturated hydrocarbons	2·6	2·0	2·4	2·4	3·0
CO	6·8	9·1	9·1	8·2	8·3
CH_4	28·6	24·6	23·7	22·3	24·8
H_2	54·5	57·5	55·6	56·3	53·9
(By diff.) N_2	4·3	3·8	5·8	6·9	6·4



COAL TEST PLANT—METHOD OF STEAMING FREE SPACE IN RETORT.

Analysis of gas during the last quarter of an hour of the steaming process was:

	%
CO_2	6·0
O_2	0·8
Unsaturated hydrocarbons	*Nil*
CO	16·2
CH_4	4·6
H_2	64·7
(By diff.) N_2	7·7

The gas temperature in a particular ascension pipe before steaming had fallen to below 100° C., and a rise to 140°-160° C. with the introduction of steam was noted.

All the above results were obtained from the South Wales coal, and similar figures have been obtained using a South Yorkshire coal, but here the increase in therms per ton was only of the same order (from 68·9 to 73·8).

Retort House Governing.

While carrying out the foregoing observations, it was noticed that the existing retort house governor, which is of the bell operating bobbing valve type, appeared to be sluggish and did not respond to the greater variation met with under conditions of steaming with one ascension pipe closed. During this period it was most necessary to maintain either a regular pressure or a regular vacuum control in the retort.

With this type of governor, the bell on which the regulated vacuum is acting is balanced by a fixed counterweight. Further, the amount of bell above the water-line varies according to the opening required on the governor valve, as a consequence of which the bell is more immersed when dealing with a small make than it is when dealing with a large make. It follows that, whatever the difference in the amount of the immersion of the bell, there is a corresponding difference in the weight that should be balanced by the counterweight. This means that the pressure of gas required to balance the system varies according to the make, and any alteration of weight necessary to balance the system can only be made manually and at infrequent periods.

After considering the matter carefully it was decided to convert this type of governor to a regulating governor valve controlled by an Arca regulator.

This regulator only takes note of the actual vacuum at the point of impulse, which is remote from the valve, and will therefore control the valve irrespective of the rate of the make of gas, or the position of the bell, and so maintain a true line within very close limits.

With this regulator, water is the operating medium. It should be provided at a fairly steady pressure of not less than 15 lbs. per sq. in., and preferably not more than 50 lbs. per sq. in. It will thus be seen that it has sufficient power to overcome any stickiness due to tar or other impurities lodging on the valve spindle or the valve itself. This in itself has considerable advantage over the bell-operated valve where tar deposits can seriously affect the sensitiveness of same.

It might be mentioned here that the vertical retort installation at the Grangetown Works was provided with governors of the bell-operated type, and considerable trouble had been experienced with burning of the gas at the top of the retorts, caused by the governors not being sufficiently sensitive to maintain either the constant and steady vacuum or pressure condition so critical in working vertical retorts and dry mains.

In view of the foregoing, and bearing in mind the success attained in the case of the horizontal retort governors, it was decided to replace these bell-operated governors in the vertical retort house with Arca regulators.

Since the installation of the new regulators this burning has completely disappeared, with the exception of one or two isolated cases, where retorts are in a bad condition at the top. It has been possible to maintain a more constant calorific value and proportionate increase in the gas make on the plant owing to the burning trouble being eradicated.

The regulator is fixed on the charging floor, and any alteration to the working of the governor can easily be made at this point.

Conclusions.

As will be gathered from the preamble, the chief object of the experiments was the production of a tar containing a higher light oil content by shielding the nascent gases and tar with an envelope of superheated steam.

In this respect the experiments and experience with horizontal retorts have not proved successful under conditions up to two-hourly steaming periods. Probably if it were possible to steam the full eight hours, a different tar might have been produced.

However, an exceptional result has been obtained, and that entirely unexpected—viz., an increase in the number of gaseous therms developed per ton of coal carbonized.

In the coal testing plant, with a travel of steam of only 6-7 ft., a maximum increase of some 5½ therms per ton of coal carbonized was noted.

In the horizontal retort house, in 20-ft. retorts, it is estimated that the extended travel of the superheated steam through the nascent hydrocarbons should give double the increase obtained in the coal testing plant.

This appears true in practice over an extended period of 5-6 months. Although it is impossible to sub-divide the stream of coal gas, it has been determined that since the introduction of the steaming of the free space in the seven beds referred to, an increase in thermal production has matured. Estimating this by taking the proportion of coal carbonized in the different units, it would appear that some additional 9-10 therms per ton of coal carbonized are obtainable under steaming conditions. It would seem that this figure is verified by another undertaking and by the Fuel Research Board.

It might here be mentioned that stop-ended retorts can be steamed by a patent taken out by Mr. King Hillier, and is well worthy of adoption in works having this type of plant.

It is considered that if it were possible to utilize both ascension pipes for the first six hours of the charge and then seal off one side by means of an anti-dip arrangement when the steaming starts, better results would accrue in gas yield and tar quality.

In any case, the subject is well worthy of further research, inasmuch as it tends to reduce the cost of car-

bonization as a result of a reduction in the quantity of coal carbonized and the increased output of the plant, thus providing factors for reductions in the price of gas—very necessary with present-day competition.

Discussion.

Mr. H. D. MADDEN opened the discussion by reading the following contribution by Dr. F. S. SINNATT, Director of the Fuel Research Board:

The experiments which have been carried out by Mr. Madden and his assistants at the Cardiff Gas-Works are of the greatest interest and they are a practical application of a suggestion made by him when he was a member of the Fuel Research Board. He called the attention of the Board to the important part played by horizontal retorts in the production of coal gas in the country, and suggested that every means of increasing the gas which could be obtained should be explored. It may be of interest to recall that the original suggestion to install a setting of horizontal retorts at the Fuel Research Station was made by Mr. Tagg, of the Preston Gas-Works, when he was a member of the Fuel Research Board. Before making his proposal in a concrete form Mr. Tagg sought the advice of some 70 of the chief gas engineers of the country. With one exception they approved of the proposal to carry out work on horizontal retorts, and their interest took a most practical and helpful form. Most of them made valuable contributions to the programme of work, and the investigations which have been and are in progress are the logical outcome of their suggestions.

Mr. Madden drew particular attention to the need for knowledge of the influence of introducing steam into horizontal retorts, and a programme was drawn up covering this problem. Some details of the results were given in the Annual Report of the Fuel Research Board for last year.

It is important to realize that over 800 gas-works in the country are equipped with horizontal retorts, and that a further 58 have horizontal, vertical, and inclined retorts. Some 40% of the coal carbonized is treated in horizontal retorts, which means over 7 million tons per annum. The importance of increasing the thermal yield in the form of gas will be appreciated especially as other sources of heat are competing so strongly for domestic purposes.

The experiments, of which details are given in the paper by Mr. Madden and his associates, bear out in nearly every particular the results obtained at the Fuel Research Station. It was found that the tar produced was not improved by introducing steam into horizontal retorts, and that an increase in the thermal yield of gas does not depend upon restricting the passage for the steam through the retort. On p. 4 of the paper the suggestion that the hydrocarbons escaped from the retort owing to the protective effect of the steam may in part find another explanation in that it is possible that a portion of the hydrocarbons are the result of the more complete carbonization of the coal at the end of the charge.

It would appear that the experience at the Cardiff Gas-Works in connection with scurfing may be due to the fact that one offtake pipe was used during the whole period of carbonization. If two offtake pipes were used until steaming was commenced there might not be such a wide variation between the thickness of the scurf at one end of the retort and the other, and it is possible that the time between the scurfing periods might be increased. The experience at the Fuel Research Station agrees entirely with that recorded in the paper upon the variation in the nature of the scurf. It would be interesting to know the cost of the additional therms obtained by steaming as compared with the normal cost of a therm of gas.

Mr. J. E. KENSHOLE congratulated Mr. Madden and members of his technical staff on the paper, and proceeded to relate the results of his own experiments on horizontal retorts, which led to an increase in the thermo yield, and a reduction in the quantity of coal carbonized.

Mr. J. H. CANNNING (Newport) also congratulated Mr. Madden, remarking that the paper would be of very great value to those who used horizontal retorts.

Mr. W. T. KENSHOLE (Merthyr), referring to the statement that a somewhat lower calorific value was invariably found on the steamed retorts compared with the non-steamed retorts and that this difference varied between 20 to 40 B.Th.U., said it would be interesting to know the value of the gas at the end of the charging period.

Mr. W. CLARK JACKSON (Neath) also took part in the discussion, at the close of which Mr. HAROLD WILLIAMS and Mr. L. L. KLEIST (Chief Chemist), who had conducted the experiments referred to in the paper, replied to the various questions.

Mr. F. P. TARRATT (President of the Institution of Gas Engineers) proposed a vote of thanks to the authors of the paper, and expressed his pleasure at being able to visit Cardiff and attend the meeting.

Mr. F. G. BROCKWAY (President, Eastern Counties Gas Managers' Association) seconded.

Mr. H. W. MADDEN, replying, said the experiments had been carried out on Welsh coal, the carbonization of which had many difficulties. Every effort, he said, was being made to get the greatest quantity of oil from British coal. Research was being carried on in all directions, and they in Cardiff were doing their bit. The whole thing had arisen as a result of the desire of the Government to see whether it was possible to produce oil in Great Britain for Admiralty purposes.

REGISTER OF PATENTS

Thermostats.—No. 398,964.

RADIATION LTD., of Birmingham, and POOLE, R., of Warrington.

No. 15,764; June 4, 1932.

Fig. 1 is a part sectional side elevation and fig. 2 a part sectional front elevation of a thermostatic device constructed in accordance with this invention.

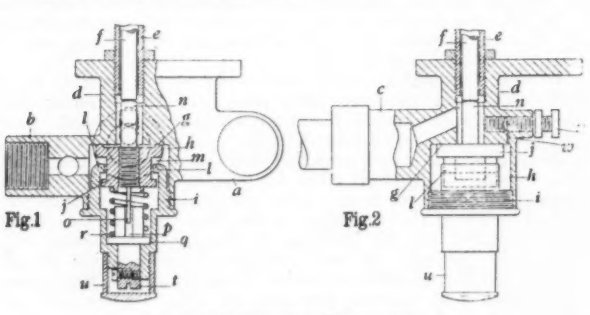


Fig.1 Fig.2

An Easily Inspected Thermostat.

A fixed body part *a* is provided with a gas inlet branch *c* and an outlet branch *b*. Also the body part is adapted by means of a branch *d* for the attachment thereto of a tubular stem *e* containing the rod *f* which acts upon the valve to be controlled, The valve seating *g*, which is preferably flat, forms one end of a chamber *h* situated between the inlet and outlet branches. The open end of this chamber is closed by means of a hollow cap *i*, and the inner portion of this member carries a valve *j* which co-operates with the seating above-mentioned. The valve is free to move to limited extent relatively to the detachable member *i* in the axial direction, but is held against rotation by engagement with the said member. The engagement may be effected in a variety of ways. Thus, in the example shown, inward projections *l* on the detachable member *i* may engage notches *m* in the sides of the valve, or projections on the sides of the valve may engage slots in the detachable member. Or guide stems on the detachable member may engage notches in the periphery of the valve.

Coaxially through the valve there is formed an internal screw threaded aperture into which is inserted an external screw threaded abutment piece *n* adapted to co-operate with one end of the rod above-mentioned, so that the rod, through the medium of the abutment piece, can press the valve off its seating, the outer or opposite end of the rod *f* being held by engagement with the outer end of the tube *e*. The end of the abutment piece *n* opposite to the rod *f* is formed with a flat tongue *o* which engages a notch *p* in a rotatable adjusting piece *q* carried by the detachable member *i*. If desired the notch may be provided on the abutment *n* and the tongue piece on the adjusting piece. Between the adjusting piece and the adjacent side of the valve is arranged a helical spring *r* which serves to press the valve towards its seating.

A stem like portion *t* of the adjusting piece *q* is arranged to extend through and beyond the detachable member *i*, and the outer end is adapted in any convenient manner to permit of convenient rotation for the purpose of moving the abutment *n* relatively to the valve *j*. In the construction shown the outer end of the adjusting piece is notched for engagement by a key. Normally this end is enclosed by a cap *u* screwed on to the detachable member. Alternatively the outer end of the adjusting piece may be fitted with a disc having a graduated periphery which co-operates with an index piece secured to an adjacent part of the removable member.

An ordinary by-pass *w* is provided as shown in fig. 2, and this is controlled by a screw *x*.

Thus the valve, adjustable abutment, adjusting piece, and spring are all carried by the removable member and form a single unit which can be readily assembled and conveniently mounted in position or removed as required. This construction, state the patentees, not only provides convenience in manufacture but also makes it possible for the valve to be inspected any time without disturbing the adjustment of the thermostat.

Utilization of Coke Oven Gas*

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The purpose of this paper is to draw attention to one particular direction in which there are considerable possibilities of improvement—namely, the more extensive utilization of coke oven gas. The importance of this has certainly been under-estimated in the past, and is probably not appreciated by most people even now, although a considerable amount of technical literature has appeared on the subject both in this country and abroad. It is fully realized that to materialize such a project would involve a considerable expenditure of capital, and in view of that, it is important to recognize quite clearly, before going into details, that no speculative experiment is being advocated, but a course of action whose ultimate success would be practically guaranteed. The grounds for such a claim lie in the extensive systems which have grown up on the Continent—in Belgium, Germany, France, and Holland—for distributing coke oven gas to industrial and domestic consumers. The Belgian gas grid, for example, has nearly 160 miles of pipeline, and is selling 85 million c.ft. of coke oven gas per mile of main per annum, while in the Ruhr there are about 600 miles of pipeline with an annual sale of nearly 50 million c.ft. per mile of main.

The economic success of a gas grid will depend upon as large a quantity of gas as possible becoming available for distribution—*i.e.*, that as large a proportion as possible of the coke oven gas produced must be a surplus. Thus, waste-heat ovens are quite unsuitable for this purpose, as the surplus available after demands for heating the ovens have been met, is small. In regenerative ovens, on the other hand, 50%, or more, of the gas produced is surplus, and this is the chief reason why waste-heat batteries are now regarded as obsolescent. The particular development which gave the greatest impetus to the Ruhr gas scheme, however, was the construction of a regenerative battery of coke ovens in Mülheim, in 1910, heated with blast furnace gas. This is technically possible because the temperatures required in coke ovens are considerably lower than those occurring in most other industrial furnaces, and a relatively poor fuel, such as blast furnace gas, having a calorific value of about 100 B.Th.U. per c.ft., may be used instead of the very rich coke oven gas, whose calorific value is over five times as great. We may note, in passing, that where the coke ovens are not built on the site of combined iron and steel works, it might be economical to install gas producers for heating the ovens. This has actually been done by the Gas Light and Coke Company at Beckton and at the Cokeries du Brabant, near Brussels. The use of coke oven gas for municipal purposes dates back some time in Germany, for as early as 1905 the Thyssen Waterworks Company was selling surplus gas from its coke ovens to Mülheim and Hamborn, and the first high-pressure gas line was laid down in the Ruhr district about 1910. The chief developments, however, have been in the post-war years. The old batteries, which were no longer of use as a result of the war and the Ruhr occupation, were scrapped, and in their place large compound and regenerative coking plants of the most up-to-date design were erected on sites carefully selected from economic and technical considerations. This was facilitated by the amalgamation of many important firms in about 1926, and, in general, coke ovens were erected on the sites of the collieries and, where possible, near the large iron and steel works. The two guiding factors are, first, that the transport of coke is much cheaper than that of the coal from which it is made, and, secondly, that a supply of blast furnace gas is required for heating the ovens. This latter point is considered of such importance that pipelines nearly three miles long were laid down in one instance, and boosting plant installed for transmitting the blast furnace gas. Where there are no blast furnaces near the collieries, gas producers are installed.

The possibility of finding a market for surplus gas has given an enormous fillip to the coke oven industry in Germany, and practice has improved correspondingly, particularly as regards output. The output of coke per oven per day has steadily increased, and the quantity of surplus gas per oven per day was nearly doubled between 1926 and 1929.

The institution of the grid scheme had one bad effect during the years of trade depression. Several municipalities drawing gas from the grid had closed down their gas-works in consequence, and many steelworks could only use coke oven gas for re-heating furnaces. While for a year or two the demands of the steelworks for coke sank to a low level, the demand for gas actually increased. As this demand had to be met, the result was an over-production of coke which at one time reached serious dimensions. This, however, could not have happened under normal trade conditions.

The chief consumers of surplus gas were originally the local iron and steel works, and the market was soon widened as it became clear that gas firing offered marked advantages over coal firing for most purposes. It must be remembered that, as a result of industrial developments, iron and steel and coal interests became bound up. Moreover, the sale of gas could be carried out unhindered by such statutory restrictions as exist in this country, and the potential market was very good, as the consumption of gas per head of population in Germany was, at that time, less than one-third of that of Great Britain. With the formation of the Vereinigte Stahlwerke A.G. extensive schemes were put into operation, and gas was transmitted to all the scattered works of this combine in sufficient quantity to render the use of raw coal unnecessary. It has often been suggested that in an iron and steel works the ideal to be aimed at is to dispense with raw coal, other than that used for producing the coke for the blast furnaces; this ideal has been realized by the Vereinigte Stahlwerke throughout the whole organization.

Even after meeting these internal requirements, surplus gas was available which had to be transmitted through considerable distances for its disposal. No particular difficulty was experienced in putting this into operation, and to-day there are pipelines running from Aachen to Hanover, while others are projected which will ensure a gas supply to South Germany.

Experience in Germany has shown that, for municipal purposes, coke oven gas can compare favourably with any other of the fuels available. Transmission losses are very low in comparison with high-tension electric current, and transport costs are not high, provided that the load does not fluctuate unduly. Moreover, German authorities claim that in recent years it has been found possible to design industrial gas-fired furnaces whose thermal efficiencies approach that of an electric furnace.

In some ways, the Belgian gas grid is even more remarkable than that of the Ruhr district, as the quantity of gas distributed per mile of main is considerably greater, as has already been mentioned, and a greater proportion of gas is used for municipal and domestic purposes.

Gas is supplied to the grid from five coke oven plants, of which it is interesting to note that one was constructed as a gas-works, and not primarily for the production of coke. This particular works is that of the Cokeries du Brabant, at Pont Brûlé, and the others are situated at Tertre, Monceau, Marly, and Hoboken. The network of the grid thus extends most of the way between the French and Dutch frontiers; the main pipeline is 73 miles long, and the total length, including branches, over 160 miles. The full capacity of the system is over 30 million c.ft. per day.

The formation of "Distrigaz," the Company controlling the grid, was facilitated by the fact that a considerable proportion of the gas is consumed by companies associated with the producers; and there are arrangements in force by which the producers undertake to provide a given quantity of gas (which is fixed largely by the estimated needs of the consumer) and the consumers in return agree to buy 80% of this quantity. The producers do not sell to new consumers without first giving "Distrigaz" the opportunity of doing so.

The physical and chemical condition of the gas is kept strictly to an agreed quality, and impurities in the gas are not allowed to exceed certain specified maxima. Infringements of these conditions are compensated by a sliding-scale of penalties; and the price of the gas to consumers is fixed by the quantity bought and the current price of coal.

In this system, special interest attaches to the coke ovens at Pont Brûlé, which were built primarily for the supply of gas to replace five gas-works at Brussels and Antwerp, under the control of the Imperial Continental Gas Association, and the capacity of the Pont Brûlé plant to provide an adequate supply of gas of the right quality to Brussels and Antwerp was considered a critical test of the practicability of the grid scheme. The reason why coke ovens were preferred to gas retorts was that there was potentially an excellent home market for the sale of metallurgical coke. At that time, imports of coke for metallurgical purposes were considerable, and there were

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even greater possibilities of disposing of the small coke in the domestic market than there are in this country, as closed stoves are in more general use for domestic heating. In fact, the sale of both gas and coke at remunerative prices was assured.

Results so far obtained augur well for the success of the scheme, although it has not yet been in operation for a long time. Capital costs were a good deal lower than they would have been in this country, and labour and other operating costs have not been unduly high; while expectations have been fully realized in the quality of the products.

France is another country in which a gas grid has been established in the last few years, around Bethune, Douai, Lille and Valenciennes, as centres, and extending over a large part of the north of France. It is interesting to note that this has been an economic success, despite the fact that the annual consumption of gas per head of population in France is only about one-third of what it is in England.

In France, as in Belgium, there has been a shortage of metallurgical coke, and even now about one-third of the coke quantity used has to be imported. Of the remainder, which is produced in France, about one-half comes from the coke ovens in the north of France. In 1930, before the slump, the consumption of metallurgical coke was 10 million tons, and the production of coke oven gas about 14,000 million c.ft., as compared with the total output of town gas of rather more than 5,000 million c.ft. Actually, the consumption of town gas was about equal to the production of coke oven gas in the north of France.

If necessary, a much larger surplus of gas could be made available for distribution, as only one coke oven plant (Anzin) is heated with producer gas, although heating by producer gas is customary in gas-works. On the other hand, there has been a tendency for the consumption of coke oven gas in the mines to which the coke ovens are attached to decrease, as it has been found more economical to burn inferior coals under the boilers.

The latest figures available show that the quantity of gas distributed annually by the grid is now of the order of 9,000 million c.ft.

Coke oven gas has been put to a variety of uses in France, and one of the most important developments has been its increased competition with fuel oil, in cases where the latter had ousted town gas. It has certain technical advantages over fuel oil, notably that it can be regenerated, and also the primary air may be regenerated; while when fuel oil is used, it is unsafe to heat the primary air above 200° C., as otherwise the oil may be decomposed before combustion, and coke deposited. It has been found most useful in cases where the material to be heated is only in the furnace for a short time, and rapid heating is therefore essential; and in many such cases considerably increased output has been obtained. Its chief industrial use has been in the metallurgical industry; in forges, for annealing and other heat treatment, and for melting (*e.g.*, bronze); but it has also been used in glass and ceramic works, and even in bakeries. Many towns, notably Metz, draw the bulk of their supply of gas from coke ovens, and in Valenciennes the annual consumption per head of population is 8,000 c.ft.

Finally, to complete any survey of development on the Continent, some reference must be made to the State mines in Holland, to which are attached coke ovens where surplus gas is distributed through a grid. Unfortunately, very few details of this system have been published, but rapid and extensive developments have taken place during the last few years.

A consideration of the present position in this country leads inevitably to the conclusion that, so far, we have lagged behind our neighbours in this respect, despite the fact that gas consumption per head of population is considerably greater in Great Britain than in any of the other countries so far considered.

The chief district in the country which has a sufficient concentration of coke oven plants to render the formation of a gas grid possible is South Yorkshire, or, more particularly, the Sheffield area. Possibilities in this direction have been carefully considered by experts in the past, and the idea has met with their practically unanimous approval. In fact, the Departmental Committee on Area Gas Supply, in reporting to the Board of Trade in 1930, went so far as to say that the formation of a South Yorkshire gas grid was urgently necessary. Nevertheless, although certain coke oven plants are selling surplus gas to municipal gas undertakings, practically no progress has been made with the scheme for the formation of a grid.

The total quantity of coke oven gas sold in this country in 1932 was about 15,500 million c.ft., and it is estimated that the potential consumption in iron and steel works alone in the Sheffield area (assuming that the gas was used for firing open hearth furnaces as well as for other purposes) would be about 23,500 million c.ft. per annum. Even this figure represents only about one-half of the calorific value of the raw coal which would be replaced by gas. It is clear that to satisfy this demand, and to have surplus gas available for other consumers, some of the older plants in the South Yorkshire area would have to be modernized, although it would probably be unnecessary to alter the location of the existing plants. In these circumstances, the figure suggested for the maximum possible output is 33,000 million c.ft. per annum, a figure which compares with the annual distribution of gas through the Ruhr grid.

The scheme proposed by the Area Gas Supply Committee provided for the collection of gas from 19 coke oven plants to a maximum of 80 million c.ft. per working day. This would involve laying down a network of 73½ miles of mains, and if it were found possible to sell gas outside the Sheffield area, no technical difficulty would be anticipated in installing compressing plants, and making the necessary arrangements for long-distance transmission.

The greatest hindrance to the furtherance of such a scheme would be the statutory restrictions at present in force. These were enacted originally mainly to protect existing gas undertakings, but as the success of the grid scheme would necessitate the co-operation of the existing gas companies, it should be possible for the necessary fresh legislation to be passed without overmuch opposition. For example, at present, new gas undertakings are debarred from transmitting gas across main roads without the consent of existing gas companies; this restriction would have to be removed, and also it would be desirable to give the Minister of Transport statutory powers to grant wayleaves, when necessary, for cross-country transmission, as is already the case for the transmission of electric supply.

There is no reason why the rights of existing gas companies should be interfered with, and it has been suggested that those parts of South Yorkshire which do not fall within any statutory area should be allocated to the grid.

It will be remembered that; in 1931, a Bill was actually put before Parliament to authorize the formation of a South Yorkshire Gas Grid Company. This Bill, which had the support of both the Sheffield Gas Company and the coke oven owners, was drawn up in the most careful terms with a view to giving full protection to existing companies. The conditions of sale were rather similar to those of the Belgian grid to which reference has been made. They provided, briefly, that coke oven gas should be sold by the grid to the existing gas undertakings, up to a figure specified by the latter, and that after meeting these requirements, surplus gas could be sold in districts not served by the gas companies. It was laid down explicitly that no existing contracts should be contravened, and that there should be no competition between the grid and the gas companies.

Despite this, the provisions of the Bill met with vigorous opposition from some quarters, and as yet little progress has been made with the scheme.

Conditions are not really favourable, either in West Yorkshire or in Lancashire, for the setting up of a grid, and the only remaining district which has any possibilities is the Cleveland area. This, again, is an important iron and steel manufacturing district, and iron and steel works would provide the bulk of the gas produced. Conditions in this district are such that the cost per therm of producer gas is considerably lower than that of coal gas, and although a certain amount of coke oven gas could advantageously be used internally in the works, in cases where a high-grade fuel was desired, most of it would have to be disposed of to outside undertakings. At the present moment, most of the gas is wasted, or burnt where an inferior fuel would be good enough, but the supply available would be more than sufficient to meet the potential demand.

It must not be inferred, from what has already been written, that no progress has been made in the internal use of coke oven gas in iron and steel works in this country; on the contrary, co-ordinated schemes of gas economy have been worked out and put into operation in a number of instances. There are several outstanding examples of this—namely, Normanby Park Steelworks at Scunthorpe, Richard Thomas & Co. at Scunthorpe, Thos. Firth & John Brown, Ltd., at Sheffield, the Consett Iron Company at Durham, and the United Steel Companies, Ltd. (Steel Peech and Tozer Branch, at Templeborough). It is interesting to note, *en passant*, that surplus coke oven gas from the Consett Iron Works is sold to the municipality of Newcastle, but it is proposed here only to give details of the arrangements at Normanby Park and Templeborough. These two are, perhaps, of the greatest interest of all, and are essentially different in that Normanby Park is a compound works, where blast furnaces are in operation and blast furnace gas is available, while Templeborough is a steelworks pure and simple, with no supply of blast furnace gas.

Although the plant at the Normanby Park Works was constructed before the war, it was designed even then with

the idea of utilizing as much blast furnace and coke oven gas as possible; the utilization of blast furnace gas being of particular importance in this case, in view of the large coke consumption necessary for smelting Lincolnshire ores. Before the installation of the present coke oven battery, the amount of coke oven gas available was limited, and the surplus was mixed with blast furnace gas for firing the mixer, and heating the soaking pits.

This still left a surplus of blast furnace gas, and consequently arrangements were made to heat the new coke oven battery with blast furnace gas. At the present time this is the only battery of coke ovens fired by blast furnace gas in this country. By this means, sufficient extra coke oven gas was released to enable the steel furnace to be fired with a mixture of blast furnace and coke oven gases.

There were certain technical difficulties to be overcome before the steel furnaces could be successfully fired in this way, with regard to both the optimum gas mixture and the question of regeneration. It had previously been thought that coke oven gas must not be passed through hot checkers on account of the dissociation of the hydrocarbons. Experiment showed, however, that this was actually an advantage, as it increased the luminosity of the flame, and also increased the heat transfer by radiation, which, in the case of clean coke oven gas, is normally very low. It was also found advantageous to modify the regenerator design; the number of courses of checkers was reduced, shallower checkers were used, and the free openings for the passage of gas were reduced.

In order to ensure regularity of supply, the coke oven gas, after leaving the bye-product plant, is stored in a holder of 100,000 c.ft. capacity at 12-in. w.g., and conveyed thence to the various points of consumption about the works; the supply being controlled by a series of distant indicators, alarms being sounded automatically when the supply of gas in the holder falls to danger point.

The hourly production of coke oven gas during a test was 443,000 c.ft.; of this, 36,000 c.ft. was used for soaking pits, 275,000 c.ft. for steel furnaces, and 132,000 c.ft. for boilers. This latter figure is of some significance. While it is obviously economical, under the conditions prevailing locally, to utilize all the coke oven gas in the works, as there is no means of disposal outside, yet the gas burnt under the boilers could be replaced, if necessary, by an inferior fuel. Probably, if the plant were working at full capacity, there would be sufficient blast furnace gas available for the purpose. This would leave an annual surplus which, under normal conditions, might approach 1,000 million c.ft. of coke oven gas available for disposal outside the works—if there were any means of disposal available.

It is easy to see that if several works were, at some future time, to put similar schemes into operation, in a district such as South Yorkshire, the question of surplus gas disposal would become one of national importance.

The case of the Templeborough Works is, in many ways, the most interesting of all, as the gas is transmitted at high pressure, and there is an elaborate and efficient system of control of distribution. The gas is drawn from the coke ovens at Orgreave, 3 miles away, and is boosted at the ovens to an average pressure of 12 lbs. per sq. in. It is transmitted through a 16-in. main which was designed to deal with a daily supply of 10 million c.ft. of gas, although, under present conditions, the consumption is only 4·5 million c.ft. per day. The gas reaches the steelworks at an average pressure of 9 to 10 lbs. and, after passing through the control system, is burnt in special burners at a pressure of about 4 lbs. per sq. in.

Most of the gas is used for firing re-heating furnaces, which were previously fired with coal or producer gas. The change took place on Jan. 1, 1933, and although at that time furnace operators at the works were by no means convinced that it would be ultimately successful, yet it soon became evident that any doubts they may have had were quite groundless, and there has been a steadily increasing demand for coke oven gas. The consumption, at present, is limited by the amount of gas available at the ovens, and there would be no difficulty in using more than twice as much gas as is used at present if this were to become available in the future.

Some of the gas is used for steel furnaces; this gas is mixed with producer gas, to give a mixture of nearly constant calorific value. Gas pressure is automatically kept constant at all consuming points, so that the burners can be adjusted to a high degree of precision to obtain either "theoretical combustion" or else to control the composition of the furnace atmosphere. This latter advantage is of an importance which it would be difficult to overestimate, as it has been found in practice that it is not possible to control the composition of the atmosphere so easily, and to the same degree of exactitude, with any other fuel. In these particular works, the use of high-pressure coke oven gas has led in every case to a considerable reduction in the amount of scaling of the steel.

As a result of the high calorific value of the gas, heating up is very rapid, and there are no delays occasioned through "waiting for heat." Increased outputs have been obtained, in consequence, with a decreased amount of labour; and in some cases, the increase in throughput has been more than 25%. It has also been possible to obtain more even heating in the furnaces, and the cost of maintenance of the brickwork has been correspondingly reduced.

The introduction of coke oven gas firing has led in almost every case to an increase in thermal efficiency of at least 25%, and in some cases the thermal efficiency has been more than doubled. For instance, continuous re-heating furnaces are attaining thermal efficiencies on the average of 60%, by using high-pressure gas, and being able to control the efficiency of combustion with the greatest amount of accuracy. The burners used are of the "Selas" type.

Results obtained at these two plants prove conclusively that coke oven gas has very definite technical advantages over other types of fuel.

There is one other interesting case of which the author has knowledge, where coke oven gas has been used with advantage to replace solid fuel and producer gas; this is a works recently erected at Tinsley for the manufacture of galvanized wire netting. Gas is supplied to the works under pressure, and is used for heating the annealing furnaces and galvanizing baths. As compared with other works, where coal or producer gas is used for these purposes, it has been found that all the operations can be carried out with a greater degree of precision, and the heat consumption per ton of finished product has been considerably decreased. There is practically no wastage of fuel, and no transport costs for solid fuel either to, or within, the works.

Although low-pressure coke oven gas has been used with success—notably at the Normanby Park Works—high-pressure gas is probably more convenient, owing to the greater ease of control, and the possibility of using smaller meters, with decreased capital costs.

It remains to sum up the present position in this country, and to suggest steps to be taken to bring about an improvement. It seems clear that coke oven gas, provided the price is reasonably low, can be used to replace other fuels—more particularly raw coal—in the manufacture of iron and steel; and also that surplus gas could be sold through a grid to municipal gas undertakings, or to other industrial consumers, to the mutual benefit of coke oven owners and consumers. There are a few combined iron and steel works where gas economy is on a highly organized basis, and where the maximum possible use is made internally of surplus gas, but even in these cases there still remains a proportion which could be disposed of outside the works.

In the case of coke ovens attached to collieries, and not associated with iron and steel works, it would obviously pay the collieries to dispose of all the gas they possibly could, and also to heat the ovens with producer gas, provided that there was a market for the extra coke oven gas thus released for disposal. Similarly, it would be desirable for coke ovens attached to blast furnaces to be heated by blast furnace gas.

Another most important point to be borne in mind is that the position with regard to the supply of blast furnace coke can certainly not be regarded with equanimity by the iron and steel industry. It is beyond the scope of the present paper to go into this question in any detail, but it will suffice to say that even now, with a return to more normal trade conditions, the shortage of blast furnace coke, and the deterioration in its quality is proving a very serious handicap to many blast furnace plants not possessing their own coke ovens—more particularly to those plants drawing their coke supplies from South Yorkshire and Derbyshire. Outputs of blast furnaces are being restricted, and coke consumptions are increasing, despite the improved demand for pig iron.

Thus it is doubtful whether any technical reorganization of the iron and steel industry will be possible without a simultaneous reorganization of coke supplies, and the matter is one for the consideration of colliery owners, and especially for collieries to which coke oven plants are attached. A prosperous iron and steel industry means increased prosperity for the coal industry; and in this particular instance it is as well to remember that the maximum rate at which coke can be burnt in the blast furnace hearth, compatible with smooth furnace operation, depends more than anything else on the quality of the coke.

The chief cause of the present unsatisfactory state of affairs is, of course, that too large a proportion of existing coking plants are out of date as regards both capacity and type of installation. In 1929, it was estimated that the

average capacity of a coke oven plant was about one-fifth as much in this country as in Germany or America; and it is axiomatic that larger plants are more economical than smaller ones provided that they can be operated at reasonable capacity. Moreover, the size of individual ovens is far too small in the majority of cases. As an example of modern developments, the new Otto ovens at the Consett Works, laid down in 1929, have a weekly output of about 130 tons per oven, which is over four times as great as the average for all bye-product coke ovens in this country in operation at that time.

So far as the type of installation is concerned, only regenerative ovens can now be regarded as adequate. In recommending the modernization of plant, it is assumed that full use will be made of surplus gas, and that as much coke oven gas as possible will be released for disposal outside the works. This being the case, waste heat ovens are of no use.

It has already been suggested that there would be no need to alter the sites of many of the existing cokeries in South Yorkshire, provided that the gas grid scheme were put into operation. If, however, it becomes practicable to build new coke oven plants, designed specially to satisfy the needs of the iron and steel industry, the locations of these plants must be chosen with the utmost care. The guiding factor must be cheapness of transport of materials. Many existing plants have been erected on colliery sites, chiefly because they were built with the primary object of developing the output of the colliery; and even if this involved considerable transport to consuming points, it would be cheaper than having the ovens nearer the consumers and transporting the coal. Conditions have changed since then, and it is now desirable to have the ovens as near as possible to the blast furnaces so that a co-ordinated scheme of fuel economy may be put into operation. Blast furnace gas should be used for heating the ovens, and, wherever feasible, as much coke oven gas as possible utilized in the works. It is recommended that, where there are a number of iron and steel works in fairly close proximity, their needs should be satisfied by one or two large central cokeries. The success of this would depend on the willingness of the iron and steel works, in the protection of their own interests, to take a fair proportion of coke oven gas. This would entail no sacrifice, but, on the contrary, would lead to a saving in fuel, as well as improved control of operation. In return, it should be possible for blast furnace gas from at least some of the works to be used for heating the ovens; or, if distances were too great for economical transmission of blast furnace gas, producers should be installed in which coke breeze, unsuitable for charging into the blast furnace, could be utilized. Such large central plants would have the advantage of being able to utilize a wider range of coals than smaller plants, and full advantage could be taken of the researches carried out in recent years on the blending of coking slacks, by the three Coke Research Committees and by other investigators.

The question of bye-products (other than gas) cannot be dealt with here in full; but it is essential that an organized scheme for marketing them be devised.

Finally, there is the all-important question of gas. Even after fully supplying the needs of iron and steel works, there will be a large surplus of gas available, and the necessary legislation must be passed to enable this to be disposed of without hindrance. It is certain that there is a potential market for all the gas that can be produced; and no coke oven gas must be used in the coke oven plant for purposes for which a cheaper and inferior fuel would suffice.

In districts like South Yorkshire—and, possibly, Cleveland—where there is a great concentration of coke ovens—the formation of a gas grid seems to be the only satisfactory solution to the problem. It may be noticed that no mention has been made of the utilization of coke oven gas for purely chemical properties. There may be possibilities of this kind—particularly if new processes are invented in the future—but the whole question is so uncertain that it is safer, in developing a scheme, not to rely upon any outlet for surplus gas existing in this direction. Gas, then, would have to be used exclusively for heating and illumination, and it would actually be to the advantage of municipal gas undertakings to buy coke oven gas from the grid at an economical figure, and redistribute it to their own consumers, through their own system. If there were still a surplus, then long-distance transmission would have to be considered, and the success of the Ruhr grid indicates that this would present no particular difficulty, even allowing for differences in conditions in Germany and England.

In the case of more or less isolated plants, surplus gas would have to be sold direct to the nearest municipal gas undertaking, as is done in many cases, even to-day, and has been done for very many years. This has been proved to be mutually advantageous to the coking and gas industries; the best evidence is afforded by the increase in the quantity of gas sold since 1921: in 1921 the figure was 1,325 million c.ft., and this was increased over 10 times in the succeeding 10 years.

The whole question is one which concerns three very important industries—iron and steel, coal, and gas—and the willing and whole-hearted co-operation of all three must be forthcoming. The policy advocated is admittedly a bold one, but, under present conditions, the only ultimate safety lies in boldness; and there is no reason why all three industries should not benefit.

Each industry would be called upon to make certain undertakings:

Iron and steel manufacturers would be required to undertake to use coke oven gas a good deal more extensively than at present, even when such gas would have to be purchased from outside undertakings. In addition to the technical advantages of coke oven gas firing, the reward would be a guaranteed supply of cheap coke of good quality, without which future progress will be impossible.

The Gas Industry would have to co-operate to the extent of not hindering the formation of gas grids, and of purchasing surplus gas from these grids, and also from isolated plants. In return they will be able to dispose of the gas to their own consumers at a remunerative price.

Colliery owners would have to ensure the production of the necessary quantities of suitable coals for coking slacks, and also, in cases where they own coke ovens, to support the formation of a gas grid if proposed. If by this means there is an increased use of gas and coke—as would certainly be the case in the long run—then there will be manifest benefits to the coal industry.

Discussion.

Dr. E. W. Smith, C.B.E. (late Technical Adviser to the Area Gas Supply Committee), said that the United Steel Companies owned coke ovens which were run with the highest degree of efficiency, and at the same time had used in the first instance large quantities of town gas for industrial purposes, and later their own coke oven gas in an extensive way.

All the coke oven gas that was available within a reasonable distance of steel works should be used by the steel industry. If the fullest use were made of this gas there would be no surplus gas in the Sheffield area, and there would be a great encouragement for the coal industry to install further plants. The reason why more gas was not used was due primarily to the fact that the steel industry had been attempting to obtain gas at prices which would enable them to produce even cheaper steel—in fact, prices which would not be remunerative to the coke ovens if the cost of distribution had been taken into account. The United Steel Companies had satisfied themselves without doubt that the estimates put forward by the representatives of the steel industry in the past had been too conservative. The steel industry could in fact offer to pay more than it had offered up to date. The author had very rightly asked that there should be a greater co-operation between the Gas Industry and the coking industries, with a view to the greater utilization through the gas undertakings' mains of coke oven gas. There was an ever increasing use of coke oven gas within the Gas Industry. The one serious condition that individual gas undertakings had made was that they should not be dependent on the supply of coke oven gas from a single coking plant. It was consequently necessary that coking plants should be linked up in the form of small grids in order that, should there be any trouble at individual coke ovens, there was a certainty of supply from the others.

Conditions Compared.

The trouble was likely to arise in the near future that there would be no cheap coking slacks available for coking use, and if larger coal were crushed for the purpose, this inevitably would increase the price of coke. The author had suggested that any proposed gas grids in this country could not be considered experimental because of the apparent success of gas grids on the Continent. It was very clear from the figures given in the paper, however, that the conditions were very different between the German and Belgian gas grids. For example, the author had pointed out that in the German gas grid there were 600 miles of main with an annual sale of nearly 50 million c.ft. per mile of main, whereas in the Belgian gas grid there were only 160 miles of main and the amount sold was 85 million c.ft. per mile of main. It was clear that the cost of distribution in the German scheme must be greatly in excess of that in the Belgian gas grid. Further, the coke ovens feeding into the Belgian gas grid were fairly well distributed along the main, and as a consequence the size of the main was relatively small and the pressure to which it was necessary to boost was low. These factors were just the factors which were most favourable for a gas grid. The original gas grid in the Ruhr district was operating under somewhat similar conditions, but the addition to the original scheme of the long tentacles distributing gas North and South had proved to be a doubtful commercial success. It seemed that the cost of distribution and compression *plus* main charges was between 5d. and 6d. per 1,000 c.ft. A distribution cost of this magnitude could only be undertaken when the cost of production of gas at the various centres of consumption was high.

These conditions in general existed in Germany owing to the long rail hauls for coal and the inferior gas-making characteristics of the majority of the German coals. In many parts of Germany an appreciable proportion of British gas coals had been imported. These conditions did not hold to anything like the same extent in England. Rail hauls for gas coals were relatively short. A considerable quantity of coal was transported by boat at very cheap rates, and the general cost of production of gas in England was lower than in Germany.

A Burden Rather than an Asset.

These conditions, therefore, restricted very considerably the distance to which gas could be boosted from the centres where the coke ovens were situated. These facts illustrated what appeared the soundest way of undertaking the useful disposal of surplus coke oven gas—*i.e.*, to consider each proposition entirely on its merits, and to undertake only those which showed themselves to be profitable, and thus gradually build up a sound commercial scheme. It was confidently felt that a grandiose gas grid which contemplated picking up supplies from a number of coke ovens, distributing this gas over many miles and running out tentacles to pick up small areas of supply, would prove to be a great burden rather than an asset.

These were the considerations which really restricted the recommendations of the Area Gas Supply Committee to the gas grid in the Sheffield area. The gas supply scheme from the Orgreave Coke Oven to the Templeborough Works of Steel Peech & Tozer illustrated the type of scheme which, in essence, guaranteed complete success—namely, the distribution over a relatively short distance of a large quantity of gas, the load factor, since the gas was used for industrial purposes, being more or less equal the whole year round, as was the production of surplus gas at the coke ovens. Further, the rise and fall of the demand for the surplus gas would coincide with the rise and fall in production of surplus gas, since both the coke ovens and the steel works were dependent on the prosperity or otherwise of the same industry.

With regard to the possibility of releasing more coke oven gas by using producer gas for heating the coke ovens, Dr. Smith said the Area Gas Supply Committee had come to the conclusion that this would only be economical if the coke oven gas had a net value of about 5¼d. and that this would only apply in rather exceptional circumstances. He asked if Major Koopman had figures which indicated a more favourable position as regards producer gas under-firing.

Another problem which had to be settled before any elaborate scheme of this kind could be developed, and which was very much in the minds of the Committee, was whether or not coke oven gas as distributed should be purified. If it were going to be used by gas undertakings, of course, the obvious reply was that they could purify the gas that they required, in their own undertakings, and re-distribute it. But there were a good many uses in the steel industry for which purified gas was an advantage. They constituted a very small fraction, but they still required it, and the steel industry would have to put in purifiers for their own purposes. If the steel industry could say that it wanted gas in large quantities, and would indicate approximately what those quantities were, there ought to be no difficulty in distributing unpurified coke oven gas; and that ought to be proceeded with at once, before the grid had developed too far on purified gas lines.

Dr. Smith expressed the hope that Mr. Ronca (Director of Gas Administration, Board of Trade) would explain what was the basis of the original Gas Acts which had such a restrictive effect, not only on the Gas Industry but on industry generally. It was conceivable that, as the type of consumer had changed and the consumer in future would be primarily an industrial consumer, there would have to be modifications in order to protect that type of consumer. However, he was sure that Mr. Ronca, as the protector of the consumer, was open-minded enough to be prepared to advocate a modification of the Gas Acts, bearing the steel industry in mind.

Question of Legal Powers.

Mr. Jacques Abady (Barrister-at-Law) suggested it was time the industries concerned sat up and thought about getting whatever extra legal powers were necessary or desirable to enable co-operation to be effected. He considered that the Gas Industry should meet the iron and steel industry and the mining and coke oven industries, and should endeavour to secure legislation on the lines of that contained in the Mines (Working Facilities) Act of 1923. That Act gave to those who, in the national interest, were desirous of raising coal, the right to go to the Railway and Canal Commission and obtain compulsory wayleaves—underground, overground, rights of airways, rights of waterways, and all that kind of thing—in order to further, in the national interest, the production of coal. It seemed to him that if the combined interests were to institute legislation and obtain a statute of that nature, the difficulties which had occurred in the Sheffield district would not arise, because it would be possible to obtain wayleaves to construct pipes across country by the very shortest routes, deviating from the roads, and pick up *en passant* some potential consumers—iron and steel works, or something of the kind—who could be bargained with and who would undertake to take the gas from the grid. It seemed that that simple method contained the kernel of the solution of the problem of distribution and the linking up of a whole lot of potential consumers, without disregarding the interests—which, of course, must be safeguarded—of gas companies and the existing and potential consumers of gas for more domestic purposes.

Progress of the South Yorkshire Gas Grid.

Mr. G. J. Greenfield (Vice-President, Coke Oven Managers' Association) resisted the impression given in the paper, that the South Yorkshire gas grid was almost non-existent. Under the working of the Sheffield Gas Company's Act, considerable advances had been made, and within two years three fresh coke oven plants had begun to supply gas, for which purpose 12½ miles of new gas mains had been laid; 9 miles of mains were also being laid to connect up with another coke oven plant and to make a second connection to one of the existing ones; and plans were under consideration for laying 7¼ miles of mains to connect to two more coke oven plants. At the same time, the Gas Company, stimulated by the supplies now made available, was greatly increasing its industrial sales, and this had been encouraged further by the improvement in trade now going on.

Comparing 1931 with 1933, the Sheffield Gas Company's purchase of coke oven gas had increased by 375 millions, from 4,755 to 5,130 millions, in spite of the fact that one of their previous suppliers had terminated their contract in the interval. It was true that the original proposals laid before the Area Gas Supply Committee had been modified considerably; that there were still coke oven plants in the area which had not so far begun to supply gas; and that there was still a lot to do before the grid was completed. But it would be very wrong to deduce from these facts that the grid was still in the nebulous stage which some passages in the paper had suggested.

The arrangements whereby the gas was distributed by a gas company or gas companies while the coke oven owners in an area joined together in a gas grid company, whose function it was to sell gas in bulk to the gas company, was an excellent one. The coke oven owners employed staffs skilled in the technical management and operation of coke ovens. This did not necessarily fit them to deal with the problem of distribution, however, nor did the coke oven owners possess suitable personnel for selling such a commodity as gas. The gas company, on the other hand, was already well qualified to deal with problems of distribution, and had of necessity developed the art of selling its commodity. The general distribution of gas must, in his opinion, continue to be in the nature of a monopoly, and where a gas company already existed there was no reason to present that monopoly to anyone else.

The author's statement that it was essential for an organized scheme for marketing bye-products to be devised might give a wrong impression, for such schemes were already working successfully in the British Sulphate of Ammonia Federation and the National Benzole Company, while producers of tar products were tending towards collaboration in marketing, in such companies as the Pitch Marketing Company and Coke Oven Products, Ltd.

The "Bold Policy."

The "bold policy" advocated by the author consisted in:

(1) The development of gas grids. It was admitted that the only districts in this country where a grid was possible were those surrounding Middlesbrough and Sheffield—and in the latter area the grid was growing rapidly.
(2) Co-operative marketing of bye-products. This was already an established fact.
(3) The establishment of a private gas grid for mutual exchange of blast furnace gas and coke oven gas between a group of coke oven plants and a group of blast furnace plants. This seemed to be the only original constructive idea in the paper. It was an excellent suggestion, provided that a district existed in which it was applicable; but the individual firm comprising coke ovens, blast furnaces, and steel mills seemed to him a more likely development.

A practical difficulty affecting particularly those who proposed to use gas for industrial purposes was that almost all the industrial processes which one associated with the possibility of gas fuel closed down at week-ends. Coke ovens and blast furnaces, however, must be run continuously, and it was not practicable to make a drastic reduction in their rate of throughput at week-ends when the industrial demand almost vanished. At those times gas must be wasted unless holders of immense capacity were provided. At such times coke ovens could use the gas under their own boilers, but this use was admitted to be much less profitable than the general industrial use of gas. It was definitely unprofitable to erect holders solely to collect this week-end gas at the coke ovens.

When erecting a new coke oven plant, it was really quite easy to arrange to heat the ovens alternatively with coke oven gas and producer gas, and even to heat part of a battery with the one and part with the other gas. Therefore, it might be profitable in some instances to arrange to heat the ovens with producer gas on week-days during the winter; and then at week-ends, or during the summer, heat part or all of the ovens with that gas which the consumers did not require, and to shut down the producers partly or wholly at such times.

Mr. Greenfield visualized a further future development of long-distance gas transmission when, at intervals along arterial roads, branches would be tapped off for gas mains to supply gas compression stations for re-fuelling motor vehicles.

The Economic Aspect.

Mr. John Roberts said the Continental experience showed that from the point of view of fuel economy the transmission of

coke oven gas over long distances was successful, but what might be good fuel economy might not be good fuel economics. One of the failings of fuel economy engineers was that they often lost sight of the economic aspect of their proposals and activities. He failed to find in the paper the proposal which was going to ensure success from the economic standpoint. The scheme outlined might make for maximum efficiency in the carbonization of the coal and the use of the gas, but it did not follow that maximum efficiency in the treatment of the raw coal would be obtained. Over-production and excess saturation was not a sign of efficiency from the economic standpoint. It was said that in Germany the quantity of surplus gas per oven per day was nearly doubled between 1926 and 1929; but they were not told of the sequel. In 1929 the production of coke in Germany was 40 million tons, but in 1933 it was only 20 million tons. In 1930 he had noticed mountains of coke in stock at various cokeries in the Ruhr district, and the quantity thus dumped was said to be some millions of tons.

If fuel economy meant the use of less fuel, the Germans had succeeded very well, but this was not sound economics. Even assuming that the decline in consumption of coke had not been anything like as great as it had proved to be, the fact that a system proved successful on the Continent was not in itself sufficient to warrant that the same system would be successful in this country. On the other hand, the fact that they had only partially succeeded did not mean that we should not be 100% successful. What was needed was a proper appreciation of the needs not only of industry, but of consumers in general. Given this, we could succeed even if the Continental industrialists failed.

The decline in Germany was due to the reduced requirements of iron smelters, and the failure to find suitable markets for the coke. He confined his remarks to the latter aspect. If they were to succeed in Great Britain they must ensure markets for the solid fuel produced, which represented two-thirds of the raw material treated. To do this they must produce a fuel or fuels which would satisfy consumers—not only the blast furnace manager, but also the domestic consumer. In this country the latter required an open-grate fuel, and in this respect the problem differed from that on the Continent, where a closed-stove fuel was required.

Manufacturing an Open-Grate Fuel.

It had been definitely proved that an open-grate fuel could be manufactured commercially and economically in coke ovens in two ways, one yielding surplus gas, and the other without surplus gas production. Both systems could be employed, but the economics of each proposition must be considered on its merits. He disagreed with the author's statement that the production of a suitable coke from a blend might require a long carbonizing period and a decreased rate of production of gas. The exact opposite was the case. Proper blends required shorter carbonizing periods and gave a higher rate of production of gas, and it was by the use of such blends that they were able to produce at high temperature free-burning open-grate coke. But this was not the only way of manufacturing such fuel.

If the gas grid system was to be successful, it must be ensured that the coke ovens were used to the maximum advantage, and produce (*a*) furnace and foundry coke; (*b*) high-temperature open-grate coke; and (*c*) medium-temperature open-grate coke. Unless they did this, a surplus of coke would be produced for which no suitable market was available, and they would reach a dead-end within a few years, as in Germany. Expansion in the coke oven and the gas industries in this country had been hindered through failure to appreciate those essentials.

The grid system would doubtless give an impetus to the coke oven construction business during the first few years, as it did in Germany, where 2,700 ovens were erected in 1928, but it would be an extremely short-sighted policy to design and build these ovens for the manufacture only of coke similar to that produced in the past. Neither fuel economy nor fuel economics would be served by a system which did not ensure the production of a smokeless fuel to displace the coal now used in wasteful fashion in open grates.

A National Plan Needed.

Mr. John Hodgson urged that they wanted a kind of national plan concerning the use of gas, coal, and coke. It was all very nne to produce cheap coke, but others were trying to sell cheap coal, cheap oil, and various other competing media for heating houses, steel furnaces, and so on, and they seemed to need some national co-ordinating body to do this thing reasonably economically for the whole country. It seemed that if they did that they should want to extend Major Koopman's grid very much farther. They would want a grid extending, say, from Newcastle to London, gas being fed into it at various points, such as the Leicestershire, Nottinghamshire, and Yorkshire coalfields, and perhaps the Kent coalfield, and instead of producing gas locally, as at Beckton, which involved carrying the coal from the coalfields to the works and producing the gas there for distribution, they would produce it on the spot. He believed that would be found to be much more economic. It depended on dealing with the vested interests of the gas companies—which again indicated a broad national planning of the whole thing.

With regard to metering, when one wanted to sell large volumes of gas one found that there was no Act which allowed any reasonable kind of meter to be used. The Act now applying stated that the meters must be stamped by the Board of Trade before they could legally be used, and that they must measure right down to zero flow; but if a meter had a capacity of more than 2,000 c.ft. there was no standard by reference to which the inspectors could stamp it. Therefore, in connection with the sale and distribution of large quantities of gas they must press for some alteration of the law so that the larger bulk meters could be stamped.

Not Such a Bad Position.

Dr. G. W. Anderson said the present position with regard to absorbing surplus coke oven gas was not as bad as it looked. Apart from the 15,500 million c.ft. of gas annually sold to gas undertakings, a similar amount (16,000 millions) went to other consumers, so that *in toto* 31,500 million c.ft., or nearly 25½% of the estimated annual production of 124,000 million c.ft. (1932) of coke oven gas in Great Britain was profitably disposed of. The rest was used by the coking plants themselves, except 3,732 million c.ft., representing 3% of the total amount of gas produced, which were "bled." This waste, of course, must be stopped, but it was difficult to see to what extent the gas now used at the ovens could be released for use elsewhere. This was surely a matter of economics. Where blast furnace gas was available, this should be used. On the other hand, if the gas for heating the ovens was to be replaced by producer gas, this could only be done when the unpurified coke oven gas was worth at the plant more than 1 to 1·5d. per therm, the estimated cost of producer gas. This figure might seem low as a value of crude oven gas, when it was compared with the price charged for town gas supplied to private consumers. It must be borne in mind, however, that the selling price of town gas included the heavy expenses incurred through seasonal and daily fluctuations in the gas demand, the distribution costs, and service to the consumer. Domestic consumers were, therefore, not profitable customers for coke oven gas, particularly when they were scattered over a large agricultural area.

It was, therefore, impossible to visualize a national gas grid covering the whole of Great Britain. The Area Gas Supply Committee had come to the conclusion that extensive distribution systems were not justified on economic grounds. Even the South Yorkshire Gas Grid would not have come into being if the mains had not been designed for a constant hourly load instead of the usual hourly carrying capacity adopted by gas undertakings, which was made equal to one-tenth of the maximum daily gas throughput. It was regrettable that the South Yorkshire scheme had not advanced further than to cover about one-tenth of the distance originally visualized by the Area Gas Supply Committee. If the steel industry in Sheffield had been prepared to take the gas which was available, no doubt it would have been supplied. It did not seem possible, therefore, that an outlet for surplus coke oven gas should be found in the replacement of town gas generally, and a fresh field of consumption must be sought, such as industry in general, and the iron and steel industry in particular. It had been shown by Mr. E. C. Evans that the erection of blast furnaces, coke ovens, and steel works in close proximity to each other was an excellent combination, from both a thermal and an economic point of view. This combination was unfortunately still rare, but highly desirable for the prosperity of the iron and steel as well as for the coking industry, as proved by the cases existing at home and abroad. In these circumstances, no, or very little, surplus gas was to be disposed of.

Another outlet for coke oven gas was for chemical purposes. This avenue had not been explored in this country, but had gained some prominence abroad. A certain section of the synthetic ammonia industry had found coke oven gas a convenient source of hydrogen, which could be obtained at a lower cost than that produced from water by special processes. A number of large plants in Belgium, France, Germany, and Holland operated on this principle. A great opportunity appeared to have been missed by the interests in this country which had sponsored the liquefaction of coal. The process, which would have taken the hydrogen from the coke oven gas, could also have obtained a good deal of its power requirements, said to amount to 2⅔ tons of coal per ton of petrol, from the waste heat obtainable from the carbonizing process in one form or another, such as by cooling of coke and the utilization of coke breeze on the spot.

The residual gas remaining from the extraction of hydrogen was very valuable either for the purpose of providing additional amounts of hydrogen or cracking or for the synthesis of a number of useful products, such as motor spirit, alcohols, aldehydes, and a whole series of other valuable compounds. Methods of manufacture had already been worked out and were in actual operation on a large scale, evidence of which was placed before the Institute of Fuel by M. Osterrieth some 16 months ago. It seemed that a much surer and bigger outlet for surplus coke oven gas could be found in industry, whether it be industry in general, the iron and steel industry or the chemical industry, than through the replacement of town gas which was efficiently produced and distributed by a highly organized industry. He believed the Area Gas Supply Committee has shown quite clearly that only under exceptional circumstances would it be justifiable to close down the gas plant and utilize coke oven gas instead. Therefore, he suggested to Major Koopman that he should review his ideas in this light and bear in mind that, where the Gas Grids on the Continent had been successful, that success had been due only to the proximity of the plant and the consumer. The Ruhr Grid had not been successful; indeed, its losses had been colossal, chiefly due to the fact that it was extended over too large an area. The Thyssen Gas and Water Works, which distributed as much gas as the Ruhr, had been operating successfully since pre-war days, chiefly because the amount of gas distributed was large,

and it was distributed to consumers in thickly populated industrial areas.

Be Careful with Comparisons.

Mr. J. F. Ronca, O.B.E., after pointing out that the so-called monopoly was not given to the gas companies for their benefit, but to prevent competing companies continually breaking up streets, urged that they must not compare the Ruhr grid with what was being done in America, Belgium, France, and Sheffield, and look upon them all as being the same kind of thing. It was stated in the paper that the Belgian grid had nearly 160 miles of pipeline and was selling 85 million c.ft. of coke oven gas per mile of main per annum; multiplying 85 by 160, it meant that 13,600 million c.ft. was being sold through 160 miles of mains. Similarly, in the Ruhr there were about 600 miles of pipeline with an annual sale of nearly 50 million c.ft. per mile of main, making a total of 30,000 million c.ft. per annum. But in England—and he was not by any means intending to tread on the toes of the people concerned at Sheffield—one could say, for the sake of argument, that the Sheffield grid had 20 or 30 miles of main, so that they had an entirely different order of things; and they were told that there was not another grid in the country. But even though there was no other grid in this country, they were selling to the gas undertakers 15,000 million c.ft. of coke oven gas per annum, which was half as much as Germany was selling, and more than Belgium was selling. Just because it might be considered good for Germany to have 600 miles of main—and he did not think it was good, because the balance-sheet came out the wrong way—it did not follow that that would be a good thing here; and the fact that in America gas was transported thousands of miles did not prove that such a course would be good here.

Nature had made some terrific geological mistakes. One was to supply America with enormous quantities of gas coming from the ground at a pressure of 1,000 lbs. and having a calorific value of the order of 1,000 to 1,200 B.Th.U. per c.ft. If we had that gas in England, should we not have pipelines throughout the country? However, the fact remained that we had to make our gas, and the fact that the Americans transported gas thousands of miles through pipelines had no more to do with England than we had to do with the moon. We had to consider the balance-sheet. It was no use saying, merely, that gas ought to go into a grid; some people would think of 50 miles of main and others of 600 miles of main. In this country we had better roads than were to be found anywhere else, but they were expensive; and because of that the cost of laying mains was very high. If we did not consider the balance-sheet we might get away with something for a generation, but the next generation would have to pay.

In view of the importance of this problem of a gas grid and gas utilization, Mr. Ronca asked if Major Koopman would add to his paper a bibliography of the published literature with regard to it.

The Return for Money.

Mr. A. F. Webber asked whether they were thoroughly satisfied that the three existing national grids—the Electrical Grid, the Railway Grid, and the Road Grid—were giving an adequate financial return on the money, which must amount to thousands of millions of £'s sunk in them. If they were not, then it was at any rate a consideration which might give them pause before they plunged into 600 miles of national gas grid, or equally ambitious water grid. Further, many of these grids were merely competing methods of taking energy about the country.

With regard to the statement in the paper that in a composite iron and steel works—with coke ovens, blast furnaces, steel furnaces, and mills—there would be a supply of surplus coke oven gas, Mr. Webber said he did not think that really would be so. The Normanby Park Works showed a surplus, but they were smelting the very lean Lincolnshire ores, and the coke consumption, although very creditably reduced during the last few years, nevertheless remained at from 20 to 25% above the consumption in other parts of the country with equally good practice, but using different ores. That was reflected, of course, in the increased amount of coal required for carbonizing and in the quantity of coke oven gas. From the figures in the paper it would be seen that a 25% reduction of the hourly output of coke oven gas at those works would practically eliminate the balance of 132,000 c.ft. per hour which was used on the boilers, and which it was suggested could be distributed as surplus; and Mr. Webber believed that that would more accurately represent general practice in other parts of the Kingdom. This had the further effect that it eliminated the Cleveland district as one in which it was possible to erect a coke oven gas grid in connection with iron and steel manufacture, because if the Cleveland works adopted what he personally would consider to be the best policy, of erecting coking plant next to the blast furnaces, on the lines followed at Normanby Park, with a reasonably good coking practice there would be little or no surplus available. The Sheffield area seemed the only one for the practical application of a gas grid.

Where is the Surplus Gas?

Mr. R. Mather also did not believe that the iron and steel industry, which was the main user of hard coke, would have permanently a substantial surplus of coke oven gas with which to supply other people. He believed that in a measurable time the coke would be made adjacent to the blast furnaces, and there would be neither blast furnace gas nor coke oven gas available. It would be of considerable advantage for separate works—say, in Lincolnshire—to be able to connect with each other in order to carry over individual fluctuations in coke oven gas or blast furnace gas, but that would be of little interest to the outside public. During the last 15 years the production of pig iron in relation to the output of steel in this country had been decreasing. He did not say that it would necessarily continue to decrease, but he believed there was not going to be the substantial market to blast furnaces for coke produced in independent coke ovens. If, therefore, coke oven gas was to be available for the grid the coke ovens would have to market their coke, to a great extent at any rate, in a different manner from that in which they had been marketing a large part of their output in the past. Major Koopman's paper had assumed, and in certain parts of the discussion it had been assumed, that the future of the gas grid linked itself to a vital extent to the iron and steel industry, but he believed the next few years would show that that connection would be less than had been anticipated in a good many quarters.

Dr. C. M. Walter, referring to the use of raw coke oven gas in connection with steel production, said he had been told in Germany that they were producing steel with coke oven gas of high calorific value, though it seemed extraordinary to him that the high-grade gas should be used for steel production. He had always been of opinion that, because one must have a big volume of gas of comparatively low calorific value, and, moreover, gas which did not contain as much water vapour as one would expect with coke oven gas, the production of steel by coke oven gas direct would not be economic. He asked, therefore, if it were a fact that coke oven gas was being used in the open-hearth furnaces.

With regard to re-heating furnaces, he asked if Major Koopman had experienced difficulty due to the presence of a considerably increased quantity of water vapour in the products, and whether he had had to mix coke oven gas with blast furnace gas to overcome the difficulty. Further, had he employed a turbo mixer for mixing coke oven gas and producer gas, or what other system had he adopted to ensure the uniformity of the mixed gas?

Speaking generally of the economics of the use of gas in the iron and steel industry, he said that, although it had been stated that it was possible to pay 2d. per therm for certain industrial operations—and he agreed that for certain purposes in steel works that might be so—he was of opinion that one would have to depend upon obtaining coke oven gas at about 1½d. per therm even at the high efficiencies which its advocates had asserted, if it were to be used in competition with other forms of fuel in coke producing districts. In districts remote from coke producing plants, the economic value of gas would obviously be high, but he was surprised at the prices at which gas was sold at Sheffield; for certain re-heating operations he would have thought that more would be used. The total amount of coke oven gas taken from the grid was only equal to the amount of gas which was sent out annually by Birmingham alone, so that it seemed that there was quite a big field for the utilization of gas for certain operations even where its economic value was high.

Mr. Frank S. Townend said that as one who had to consider many grids and distribution schemes, he had come to the conclusion that the cost of distribution in this country—the capital charges on the mains and the cost of compression—did not permit more than the distribution of relatively large quantities of gas over relatively short distances. A long main might in itself be a paying proposition, but as soon as one considered tapping off small quantities from that main for supplying small centres—and there were many in this country which did not take a million c.ft., and often not 500,000 c.ft. per day—those two factors alone would easily cost up to 6d. or 8d. per 1,000 c.ft.

A National Grid Impossible.

The Chairman (Mr. Edgar C. Evans) said the discussion had shown clearly that a national grid in this country was impossible. Alternative fuel supplies, such as coal, and so on, were so widely distributed that any attempt to send gas from a coke producing area over any considerable distance would be nullified. The advantages of coke oven gas had been pointed out by Major Koopman—better control, a higher yield of the product, lower oxidation, higher output, and increased thermal efficiency. His suggested output increase of 25% was rather a remarkable figure, and the Chairman asked whether that increase was due entirely to the use of coke oven gas, or whether other factors which perhaps were not altogether obvious had intervened, those other factors being better control, better treatment of the material, and so on. Those advantages were worth a great deal; but how much were they worth? Why had there not been in the Sheffield area, which was peculiarly suitable as a local grid area, a far better degree of utilization of coke oven gas? The price of 1s. per 1,000 c.ft. for purified gas was still far too high for the steel works to be able to pay economically. In the Rotherham area, unpurified gas was being sold to-day, through the gas undertaking, at 1¼d. per therm. At one works coke oven gas was used for re-heating furnaces, instead of using the producer gas which had previously been used. By using this gas at 1¼d. per therm, or 7½d. per 1,000 c.ft., a handsome profit was shown, partly due to reduction of labour, and partly to reduced oxidation, greater facility, and greater control. The use of coke oven gas was then extended to four or five other furnaces of the same type; but the position then was that, with the five furnaces working on coke oven gas, the owners of the works were paying as much for the coke oven gas as they would have been paying for producer gas. The point was that when only one of the furnaces was working on coke oven gas, they were working to perhaps 50% capacity. But to-day they were working at from 80 to 90% capacity, so that they could operate

the producers to capacity and reduce the cost of production of producer gas, and it was as cheap as coke oven gas at 1¼d. per therm. That was the kind of problem which the iron and steel industry had to face. They were ready to use coke oven gas, but the price which they could afford to pay for it, with large-scale utilization, could not exceed figures of the order of 1¼d. to 2d. per therm, dependent on the quantity and on the percentage output at which the plant was working, and the requirements of the works.

There was a very serious shortage of coke, particularly in the Midland area, and coke quality had deteriorated enormously during the last few months; probably the supply of high-class coking coals in the Midland area was not sufficient to go round at the present time and to maintain coke quality as required for blast furnace purposes.

The Author's Reply.

Major Koopman, replying, said he had stated clearly that grids would be useful only in certain parts of this country; and he was not calling for a national grid, for he knew very well that, taking into consideration the economics of all the operations with which it would be connected, a national grid would certainly not be in the national interest. But he wished to stress the point that a grid, with its full significance, and especially from an industrial utilization point of view, should be realized and ought to have been realized by now in South Yorkshire; no grid had yet been realized in South Yorkshire, apart from a certain number of mains directed towards gas-works in order to supply them.

Replying to Dr. Walter, he said that at the Hoesch Works at Dortmund, there was used 100% straight coke oven gas, non-purified, and they produced a ton of steel on a consumption of 14 therms on the average. They did exactly the same thing at the works of Messrs. Richard Thomas & Co., Scunthorpe. With regard to the price of coke oven gas, he had not stated in the paper that it was always worth at least 2d. a therm, or even more; in certain cases it was certainly worth less.

As to increased output, there were a great number of re-heating furnaces—even efficient coke-fired or producer gas fired furnaces—in the steel industry with which at a certain through-put one had to wait for heat. When coke oven gas was used, however, there was no waiting for heat. The Chairman had asked whether the increase in the efficiency was due solely to the coke oven gas; there was such complete utilization of all the heat that one did obtain such increased efficiency.

Discussing the general economics of the problem, Major Koopman said he would not advocate increased coke production capacity, for he considered that the present capacity, or the present number of coke ovens, was sufficient to meet the needs of the country. There were a great number of coke ovens in this country which ought by now to be scrapped, and they would be in a good many districts. What he was advocating was that the present available gas be utilized, and that the coke ovens which were situated near blast furnaces should be heated by blast furnace gas.

Written Contributions.

A number of written contributions to the discussion were submitted.

Mr. L. H. Sensicle recalled that in a letter to *The Times* of Aug 15, 1933, he had indicated that a very desirable development would be the installation of a number of hydrogenation plants in different parts of the country, in association with bye-product coking installations in the coalfields or even at certain of the larger gas-works. It was suggested that such hydrogenation installations could be relatively small, and might have a daily coal treating throughput up to 200 tons per day. The main requirements of a hydrogenation plant were hydrogen, heat, and power, and each of these three commodities could be made available at low cost at modern coking installations situated at colliery districts. The hydrogen could be prepared from the coal gas yielded at the ovens, in which it existed to the extent of over 50%, and other valuable constituents could be recovered at the same time. The development of the coking, and incidentally of the iron and steel industry in this country, had been hampered for many years, partly by the fall in value of the old-type bye-products, such as sulphate of ammonia and coal tar distillates, and especially by the lack of a profitable outlet for the surplus gas from the ovens. The proposal was to treat all the gas yielded from a battery of ovens in order to recover the hydrogen and certain other constituents, and to return the residue to the ovens for heating purposes. A further feature which might be incorporated would be the recovery of unused hydrogen from the hydrogenation chambers, by passing the effluent hydrocarbon gases through the hydrogen separation unit with the coke oven gas.

A valuable feature of this mode of operation might be that the rich hydrocarbon gases, unavoidably produced in the hydrogenation process, could be liberated for sale in the compressed condition as "bottled" gas for motor propulsion, rather than being consumed in a destructive heat and steam treatment process for the production of further hydrogen, as proposed at Billingham. These hydrocarbon gases had a calorific value at least twice that of town gas, and were thus capable of giving a vehicle of given cylinder storage capacity twice the range of action. If the "bottled" gas industry were to develop, as anticipated, it was clearly desirable that distributing centres should exist in various parts of the country.

Less Vulnerable to Attack.

From the national viewpoint also, a distribution of plants would be a safeguard, as they would be less vulnerable to aerial attack than would a centralized industry. This point was more important than at first appeared, for the reason that coke oven plants equipped for hydrogen production could be turned over to the production of synthetic ammonia and nitric acid, which were needed in large quantities in time of war for the manufacture of explosives.

A normal modern coking installation, carbonizing, say, 1,200 tons of coal a day, could be adapted in a self-contained manner for the production of over 10 million gallons of petrol per annum, by the addition of a relatively small hydrogenation plant to treat up to 200 tons of coal or tar per day; while there would be additionally produced rich hydrocarbon gases, equivalent to a further 3 or 4 million gallons of petrol, if supplied compressed for motor transport. The national importance of such a possibility might be gauged from the fact that, if all the coke oven plants in the country were adapted in such a manner, they would be capable of producing the whole of the motor fuel requirements of the country. It was a far cry to any such eventuality, but the magnitude of the potentialities should obviously be kept in mind. In the event of anticipated national emergency, on the other hand, there was no reason why the country could not, within a period of little more than a year or two, render itself totally independent of imported sources of oil or of the importation of nitrogen bases needed for war purposes.

The bye-product coking industry had been too dependent on the iron and steel industry in the past. This need not be the case in the future, as great scope existed for expansion if oven coke, which was both clean and dry, and suitably graded, became popularized for domestic use in open grates and closed stoves. While 40 million tons of raw coal were used wastefully each year in domestic grates, the total sale of coke from coke ovens rarely exceeded 12 million tons per year, and this was considerably more than the corresponding figure for the Gas Industry.

The country could, with advantage, look to the gas and coking industries for the solution of many of its fuel problems; but much re-organization was required. Most of the coke oven plants in Great Britain were obsolete, and the great majority were prolonging a precarious existence under the care of technical staffs whose energies might be more profitably employed on modern installations. These plants could not be run were it not for the fact that their capital value had long since been written off, thus leaving no capital charges to be added to the high cost of maintenance and operation. The largest single item in the cost of manufacturing iron and steel was the price paid for coke, and it was thus safe to say that the obsolescence of our coke-making plants was an important contributory factor, hampering our efforts to compete with Continental steel makers. The long-continued delay in the modernization of coke oven plants arose mainly from one cause—that technique in the industry had outstripped the ability of coke oven owners fully to exploit the advances made. Coke oven plants could now be built, capable of yielding large volumes of surplus gas and high-pressure steam for power purposes, but the difficulty was to find a profitable outlet for the gas and energy; until such an outlet was assured it was unlikely that owners of plant would hasten to spend the capital necessary to modernize their installations.

The Viewpoint of the Metallurgist.

Dr. G. E. Foxwell stated that there was a good deal of indirect evidence in the paper that Major Koopman was not primarily a coke oven technologist, nor was he closely in touch with the ideas and aspirations of the more advanced coke oven technologists, so that he voiced the viewpoint of the metallurgist—*i.e.*, the user of the gas, and not the seller. When the gas grid was first recommended by the Area Gas Committee, Mr. Clifford Armstrong had written to the Sheffield Press, maintaining that the suggested price of 2d. per therm at the steel works was too high. Major Koopman, however, had said that at this price coke oven gas would have a ready and assured market. The whole paper breathed the ardent desire of the metallurgist for a supply of coke oven gas, and it was highly encouraging to the coke oven industry. Why had not the South Yorkshire gas grid been developed, to be ready for the opportunity now waiting?

The author had put the quantity of surplus gas at 50%. But this figure must refer to old ovens only, as it was nearer 70% in the modern oven working on South Yorkshire coal. The insistence that waste-heat ovens were no longer desirable was unnecessary; Dr. Foxwell believed that it was many years since a new battery of waste-heat ovens was built—and constructors no longer offered these ovens. The economics of new construction were such that, unless a reasonable return could be secured from the gas, it was uneconomical to build new plants. That explained Major Koopman's observation that far too many British coking plants were out-of-date; until the gas could be utilized it would not be possible to re-build them.

It seemed that Major Koopman had rather mixed up the metallurgical use of gas with the Gas Industry, whereas it would be far preferable to keep them separate. This was one reason why the location of the coking plants at the iron and steel works should be encouraged. It was difficult, however, to carry this policy to its logical conclusion until the iron and

steel industry put its house in order by situating steel works and blast furnaces on closely neighbouring sites. Another reason for including the manufacture of blast furnace coke in the steel industry was the very pertinent observation, made in the paper, that with the shortage of furnace coke there was a deterioration of its quality, which was proving a grave handicap to the iron maker. It was deplorable that colliery owners should allow their coke to deteriorate from reasons quite within their control. The control of the quality of the coke was probably one of the greatest single economies that could be made in the manufacture of pig iron, and that, coupled with the utilization of coke oven gas, which frequently could not be used properly when the coking plant was situated at the colliery, must inevitably lead to the coking plants leaving the collieries. It seemed a classic example of the collieries killing the goose that in the past had laid them many golden eggs. One point against this policy—and one which Major Koopman appeared to recognize—was that unless the steel works owned their own collieries it would be difficult for them to secure coking coal at a reasonable price; and this was made more difficult by reason of the quota system.

In papers published in the U.S.A. it had been stated that considerable advantages could be gained, from the steel works angle, by removing most of the sulphuretted hydrogen from coke oven gas before sending it to the works; it would be interesting to know if this were so, and, if it were so, why it was important to use sulphur-free gas. The Ruhr plants were removing H_2S from their gas, and many of them were using the Thylox process, which could easily be applied at coking plants in this country.

Mr. O. W. Roskill suggested that the facts did not support the author's view, concerning the utilization of coke oven gas for purely chemical properties, that the whole question was so uncertain that it was safer not to rely upon any outlet for surplus gas in this direction. He pointed out that in the Nord and Pas de Calais Departments of Northern France during the year 1932-33, 24% of the available surplus of coke oven gas would have been used for nitrogen fixation if all the nitrogen plants installed in that area had been working to capacity. Similarly, of the surplus gas available in Holland in 1931-32, 30% would have been used for nitrogen if both the coke oven and nitrogen plants in the State mines had been working at their full output. In the year 1932 the nitrogen industry in Belgium had consumed about twice as much coke oven gas as was sold for domestic purposes, and as was supplied through the long-distance transmission. Since that date, however, the domestic consumption had increased enormously. It was well known also that the Ruhrchemie were putting up a plant, approximately equal in capacity to the Leuna synthetic petrol plant, for the hydrogenation of bituminous coal, where the hydrogen necessary for the process was to be obtained from coke oven gas.

The Ceramic Society at Llandudno

Refractory Materials Section

The Spring Meeting of the Refractory Materials Section of the Ceramic Society was held in connection with the Clay Convention at Llandudno on May 7 to 10.

A further paper by F. H. Clews, M.Sc., A.I.C., and A. T. Green, F.I.C., F.Inst.P., on

The Permeability of Refractory Materials to Gases,

consisted of Part IV., dealing with the influence of the firing process on the permeability to air of fireclay materials.

Material from the North of England, supplied as "green" blocks, was used for two series of experiments, the treatment being designed to simulate the industrial firing treatment. In the second series the time of heating was varied in certain stages, the chief modification being a decided lengthening of the third stage so as to complete the oxidation of all carbon before vitrification could begin. For third and fourth series of experiments were used respectively unfired fireclay bricks of two different Stourbridge clays, both series being subjected to similar firing treatment.

The results are collected in tables, and are also displayed with the aid of graphs. The authors give the following summary:

1. The permeability to air of three types of fireclay at stages representing the green to the finished state has been measured, and found to increase continuously up to 1,200°.
2. It is concluded that as a result of firing over this range the number of pores decreases, but that their size increases. This is in keeping with the contraction which occurs on firing.
3. Continued vitrification at temperatures up to 1,400° has been found to lead in five instances to an increase in permeability, and in five others to a decrease.
4. It is suggested that vitrification, *per se*, leads to a decrease in permeability. The observed increases are attributed to the inability of certain types of material to withstand without cracking the strains imposed by vitrification and subsequent cooling.
5. The low values found for the permeability of dried (120°) fireclay emphasize the strains which can be produced by undue haste in the water-smoking period.
6. The low values for the permeability of the fireclay goods at 650° explain the extended time required for complete elimination of carbon from some clays at this temperature.

An important paper by R. J. Sarjant, M.Sc., A.R.C.Sc, D.I.C., discussed

"Some Factors Affecting Furnace Heating Practice: II."

From data furnished in previous papers by the same author, it has been demonstrated that losses of heat in industrial heating practice due to storage of heat in the refractories which make up the furnace structure amount to about one-third of the total potential heat of the fuel used. Such heat storage should have more attention than it has hitherto received.

The difficulties attached to experimental investigation of the subject have necessitated resorting to mathematical analysis, and unfortunately the results obtained in this way are not easy of practical application by such persons as do not possess a considerable knowledge of higher mathematics. This disadvantage will doubtless be mitigated with the accumulation of information. Meanwhile progress has been effected by establishing laws of convection applicable to furnace heating, and by making use of the ascertained fact that radiation from a luminous flame is vastly greater than from a non-luminous flame.

In four appendices to the paper are given various formulæ, symbols, references, &c.

The third contribution was a very long paper by A. H. B. Cross, B.Met., and W. J. Rees, M.Sc., F.I.C., reporting the results of an investigation, which extended over a period of four years, concerning

Basic Refractories for Steel-Melting Furnaces.

It may not be out of place to note very briefly certain conclusions, drawn from the results of this investigation.

Addition of kaolin to dead-burned Grecian magnesite caused reduced burning shrinkage, which is believed to be due to the formation of minerals of lower specific gravity. Similar effects on adding small proportions of magnesite to kaolin seem to be due to bloating within the briquettes. Expansion observed on firing some mixtures to 1,610° C. after previously firing to 1,410° C. is ascribed to bloating. Precalcination of the mixed raw materials seems necessary, the burning shrinkage being undesirably high when this is not done.

The addition of kaolin to magnesite causes lowering of the thermal expansion, and the spalling tendency of such mixtures may be studied by a simple quenching test. The typical mineral of all mixtures of magnesite and kaolin is cordierite, a double silicate of magnesia and alumina, the proportion of this mineral present depending on the time and temperature of the heat-treatment. The cordierite becomes decomposed under certain conditions, and sometimes cristobalite appears instead of tridymite.

Mixtures of dolomite and kaolin were also investigated, and such mixtures containing 80 to 95% dolomite were found interesting as refractories. Various high dolomite-kaolin mixtures resist hydration by cold water, boiling water, and wet steam very well when fired to 1,560°-1,610° C. Kaolin additions cause more rapid under-load failure of dolomite. unlike the effect of adding kaolin to magnesite. Mixtures of dolomite, kaolin, and felspar may show good under-load refractoriness.

London and Southern District Junior Gas Association

ANNUAL BUSINESS MEETING

The Annual General Business Meeting of the London and Southern District Junior Gas Association was held on Friday, May 4, at the London School of Hygiene and Tropical Medicine (University of London), Keppel Street, W.C. 1—Mr. H. C. SIMS, Assoc.M.Inst.C.E., the President, in the Chair.

The ASSISTANT HON. SECRETARY (Mr. G. Gardiner, Wandsworth) read the minutes of the last general meeting, which were confirmed, after which the following Scrutineers were elected on the proposition of Mr. H. W. H. BUTTERFIELD (South Suburban Gas Company), seconded by Mr. E. J. WARREN (Wandsworth), Mr. F. Graham (South Suburban), Mr. W. J. R. Waterfield (Gas Light and Coke Company), and Mr. R. G. Plummer (Gas Light and Coke).

The financial statement for the past year was submitted by the HON. TREASURER (Mr. H. G. Soar, Gas Light and Coke), this showing a balance in hand of some £180, as compared with £186 brought in. Mr. Soar stated that this was the eighth occasion on which he had had the pleasure and privilege of presenting the annual accounts, and he paid tribute to the help he had received from the Officers and Council and also Mr. S. C. Waldock, their Hon. Auditor.

The financial statement was unanimously adopted on the proposition of Mr. B. W. DAWKINS (Gas Light and Coke), seconded by Mr. C. F. PETERSEN (East Grinstead).

PRESIDENT'S REPORT.

The PRESIDENT then submitted his report upon the work of the Association during the past session, in the course of which he said the success of the session was largely due to the unremitting hard work of their Hon. Secretary, Mr. Higton, whose great help Mr. Sims wished to take this opportunity of acknowledging. He also mentioned their Hon. Assistant Secretary (Mr. G. Gardiner) for the work and time he had given to the Association, and their Hon. Treasurer (Mr. W. G. Soar), who was a tower of strength to the Association.

They had now come to the end of a successful and interesting session. They had had papers presented which had been of a very high order and had provoked animated discussions. Many distinguished visitors had honoured the Association by their presence on most of these occasions, and had freely given them the benefit of their knowledge and experience in the subject matter dealt with in these papers. The visits during the session had on the whole been well attended, the one to Ford's Works at Dagenham last November particularly attracting a large number of members, over 150 being present on that occasion. Over 90 members made the journey to Birmingham to visit the British Industries Fair. They were grateful to all their hosts for their kindness and hospitality. The annual dinner last November was well attended, though the number was not up to the expectation of the Council; many distinguished members of the Industry were there as visitors. The membership of the Association continued to expand, said the President; and their finances, under the able and careful management of their Hon. Treasurer, were in a very sound condition.

The Milbourne Silver Medal for the best paper presented by a member for the session 1932-33 was presented to Mr. P. Richbell, of the Croydon Gas Company, at the opening meeting of this session. Mr. P. Richbell's paper had also gone forward for the Institution Bronze Medal. Mr. Risby has gained the S.B.G.I. Silver Medal.

NEW MEETING HALL.

The Council very early in the present session recognized that the Association had outgrown the accommodation at the Westminster Technical Institute, where they had been for so many years. Dr. Long, the Principal, was approached with the view of providing better accommodation; but this proved impossible, and the Council very regretfully had to look elsewhere. Deep regret was felt at having to sever so long an association with the Westminster Technical Institute, and the Council gratefully acknowledged the help and facilities afforded the Association by Dr. Long and his predecessor, Mr. Stuart Kerr. The increase in status and influence of the Association was another factor in the decision made by the Council to seek better accommodation. A sub-committee went thoroughly into the matter; and, after passing in review several alternatives, finally recommended this building, the School of Hygiene and Tropical Medicine. This was unanimously approved by the whole Council, and since January of this year all their meetings had been held here. The use of this building entailed additional cost to the Association, and they would see from their circulars that notice had been given to increase the subscription for membership from 10s. to 12s. 6d., and he suggested that this was a very small increase for the very much better facilities they were getting for their meetings.

The Council, continued the President, had had very regretfully at times to refuse applications for membership of the Association, owing to applicants having not passed the standard of examination required for membership; and yet they had, on the other hand, felt that every encouragement should be given to these younger members of the profession who were on the threshold of their careers. It had been decided, therefore, to form a studentship class to meet these cases. In conclusion, Mr. Sims acknowledged the support given him during the session by his colleagues on the Council and all the members.

The adoption of the President's report was moved by Mr. J. GRAYSTON (Lea Bridge), seconded by Mr. W. J. SOAR (Gas Light and Coke), and unanimously carried.

Mr. A. R. COWLISHAW (South Metropolitan Gas Company) moved and Mr. A. E. RICHARDSON (Croydon) seconded a hearty vote of thanks to the Officers and Council of the Association for their work during the session, and this was unanimously accorded.

On the proposition of Mr. R. SUMMERSON (Luton), seconded by Mr. H. J. RISBY (South Metropolitan), it was agreed that a suitable testimonial be presented to their retiring President (Mr. Sims) and, in acknowledgment, Mr. SIMS said that he would always look upon it with pride, for he felt it an honour to be elected President of this Association, and he had enjoyed every minute of his year of office. He had received the whole-hearted co-operation of his colleagues on the Council and all the members, and he had not had a moment's worry from the time he took over the Presidency last October.

ALTERATION OF RULES.

On the proposition of the HON. TREASURER, seconded by the HON. SECRETARY (Mr. F. H. Higton), Rule 6 was amended to provide for an increase in the subscription of members and associate members from 10s. to 12s. 6d. per annum, several members speaking in support of the motion.

It was explained to the meeting that the Council was unanimously agreed that this alteration was necessary to allow of the continued use of the School of Hygiene and Tropical Medicine as the meeting place of the Association, the increased membership and the high status of the Association making it essential to arrange fresh accommodation for their meetings. Mr. Higton observed that they were the premier Junior Gas Association in England, and they had found that the Westminster Technical Institute was not large enough to accommodate all the members who attended. They very much wanted to be able to go on using the present fine hall, which would only be possible if a return were made to the 12s. 6d. subscription which prevailed in the Association some years ago.

The following resolution was also adopted by the Association—namely, that cards be printed and sent to the various principals of Technical Institutes. these cards to be sold at 2s. 6d. each to students, permitting attendance at all the technical meetings of the Association during the current session.

THE NEW OFFICERS.

The following Officers and Council were then elected for the 1934-35 session:

President.—Mr. F. C. Smith (Gas Light and Coke Company).
Senior Vice-President.—Mr. J. M. Webber (Croydon)
Junior Vice-President.—Mr. R. Summerson (Luton).
Hon. Treasurer.—Mr. H. F. G. Soar (Gas Light and Coke Company).
Hon. Secretary.—Mr. F. H. G. Higton (East Surrey).
Assistant Hon. Secretary.—Mr. G. Gardiner (Wandsworth).
Hon. Auditor.—Mr. S. C. Waldock (Gas Light and Coke Company).
Council.—Messrs. H. H. Brown (Southampton), H. W. H. Butterfield (South Suburban), G. Gardiner (Wandsworth), R. N. LeFevre (Gas Light and Coke), S. H. Miles (Reading), H. J. Risby (South Metropolitan), P. Richbell (Croydon), and P. F. Scarth (Gas Light and Coke).

A vote of thanks to the Scrutineers was unanimously

carried on the proposition to Mr. HIGTON, seconded by Mr. GADSBY (Gas Light and Coke).

The following members were appointed to serve on the District Education Committee:

Mr. T. H. Prater (Isle of Thanet).
Mr. F. C. Smith (Gas Light and Coke).
Mr. J. M. Webber (Croydon).
Mr. F. H. Higton (East Surrey).

It was agreed on the proposition of the PRESIDENT, seconded by the HON. TREASURER, that a letter be sent to Dr. J. N. Long, M.Sc., Principal of the Westminster Technical Institute, expressing the thanks of the Association to him and his staff for the help and facilities afforded them.

A vote of thanks to the Technical Press was heartily accorded on the proposition of Mr. WEBBER, seconded by Mr. GARDINER, and this was duly acknowledged.

In concluding the meeting, Mr. F. C. SMITH, the President-elect, expressed his sincere thanks to the members for his election.

Midland Junior Gas Association

ANNUAL MEETING

The annual meeting of the Midland Junior Gas Association was held at the Council House, Birmingham, on Thursday, May 3—The PRESIDENT (Mr. S. K. Hawthorn, of Birmingham) in the chair.

The annual report and statement of accounts were of a satisfactory character. The Council stated that the usefulness of the Association had been maintained, and the attendances at the meetings and visits to works had been good. The membership stood at 279 compared with 273 last year. The number of successes obtained in the examinations of the Institution of Gas Engineers by members of the Association was satisfactory. The Education Scheme was now running smoothly, early difficulties having ceased. The financial report showed a balance in hand of £28 on the year's workings, and the total amount held by the Association was now £95.

NEW OFFICERS.

The following Officers were then elected for the session 1934-35.

President.—J. H. Wainwright (Halesowen).
Senior Vice-President.—F. L. Atkin (Birmingham).
Junior Vice-President.—F. A. Jenkins (Leamington).
Hon. Secretary.—A. Hill (Birmingham).
Assistant Hon. Secretary.—F. A. Grant (Birmingham).
Hon. Treasurer.—G. W. Smith (Birmingham).
Hon. Auditor.—W. P. Timbrell (Birmingham).

Mr. W. N. Smirles (Birmingham) and Mr. S. Brockbank (Walsall) were elected to vacancies on the Council, and a vote of thanks was accorded to Mr. E. T. Pickering (Birmingham), Mr. R. L. Greaves (now of Stockport), and Mr. W. Macnaughton (Wolverhampton), the retiring members of the Council, for their services.

The PRESIDENT referred with satisfaction to the way in which the Education Scheme was working, and to the fact that the number of students coming forward was satisfactory. Their thanks were due, he said, to Messrs. H. R. Hems, W. Macnaughton, R. G. Marsh, and W. L. S. Spinks for their services as members of the Midland District Education Committee, and also to Mr. W. J. Pickering for his work as representative of the Joint Council of the Junior Gas Associations on the Executive Committee of the General Education Committee.

EDUCATION SCHEME.

A vote of thanks was accorded to the members of the Education Committee, and they were re-elected with the exception of Mr. R. G. Marsh, who asked to be relieved of this service, Mr. F. A. Jenkins being appointed in his stead.

Mr. HEMS, in acknowledging the re-election of the Committee, stated that its work was now much less arduous than it was a few years ago. The scheme was now working almost automatically. He came in contact with the secretaries of other committees, and learned that some of those committees, particularly those in Scotland, had much more work to do than they had. There was still a feeling that more students should enrol, and if an analysis were taken of the figures from the various centres, he thought it would be seen that more men might be expected as students from certain districts.

On behalf of the Education Committee, he expressed the hope that every effort would be made to induce the younger members of staffs to take advantage of the Education Scheme. Whatever other forms of instruction they were taking, it was essential that they should go through the course mapped out under the scheme either as internal or as external students.

The meeting approved a recommendation to contribute three guineas to the Sir Arthur Duckham Memorial Fund.

The CHAIRMAN stated that the Society of British Gas Industries had awarded their medal for the session just ended to Mr. F. L. Atkin, of Birmingham, for his contribution on "The Design of Town Gas-Fired Furnaces."

ADDRESS BY MR. R. S. RAMSDEN.

Mr. R. S. RAMSDEN (General Manager and Engineer of the Leamington Priors Gas Company and President of the Midland Association of Gas Engineers and Managers), in a short address, congratulated the Association upon the excellent work it was doing. It was well managed, the right spirit animated the members, and the general standard of the papers was high. They owed much to the pioneers of the Association, and in this connection he referred to the whole-hearted service rendered many years ago by Mr. Berridge, Mr. Charles Meiklejohn, Mr. Bywater, and Mr. James Hewett. As a youth at the Burton-on-Trent Gas-Works, he remembered his father calling his attention to an excellent paper by Mr. Berridge in 1901. It was on the training of a gas engineer, and what Mr. Berridge stated then applied, with just as much force, to-day. He observed: "The education of the gas engineer is never complete, and so long as scientific discovery continues to progress and develop, the engineer who ceases to progress remains not merely at rest, but falls behind."

Such a fate as that, said Mr. Ramsden, could not befall a man who took an interest in the work of the Midland Junior Gas Association. The keynote of its work was: "For our common good and to the betterment of our knowledge of the Great Industry to which we belong." The old volumes of transactions of the Association were a source of help to them in their work. He commended to them particularly a book by the late Sir Courtenay Boyle on "Hints on the Conduct of Business." He was Secretary of the Board of Trade at the time he wrote this work, and, although it was not specifically written for any particular industry, it contained a mass of important information and advice which was singularly applicable to them to-day. The points stressed in the book were those of method, of letter-writing (in which it was pointed out that all ambiguities should be avoided), and proper recognition of the status of assistants. If the work of a gas undertaking was de-centralized then it was most important that every assistant should be made to feel that his job was valuable and that his contribution to the whole undertaking depended upon the way in which he carried out his work. Another point of interest to young staff men related to interviews. In a gas-works, as in business relationships, grievances, real or imaginary, sometimes arose, and very frequently, though, of course, not always, better results could be achieved in clearing up difficulties of that kind by interviews. It often happened by the mere exchange of letters one failed to realize the other man's point of view.

Mr. Ramsden added that a good deal of information, useful to young men in the Gas Industry, was to be found in another volume entitled "Letters from a Self-Made Merchant to His Son" (by Lorimore). In these various books the need of loyalty—loyalty to one's chief, to one's colleagues, and to the workmen under one's authority—was the keynote. He hoped the tradition of the Association in producing every year a good list of contributions of technical interest would be fully maintained. Its importance from the point of view of social contact among those engaged in a common cause could not be exaggerated, and by the present system of mutual co-operation, which received so much support in the Midlands, he thought they need have no fear as to the future of the Industry. All the same, if the Industry was to keep to the front, it was necessary they should pull their weight all the time. He congratulated the Association upon the successes in the recent examinations, and paid tribute to the Birmingham Gas Department for the help and encouragement they gave to the work of the Association.

A vote of thanks was passed to Mr. Ramsden on the

motion of Mr. W. L. S. SPINKS, who testified to the interest he had shown in the education of gas fitters. The resolution was seconded by Mr. MACNAUGHTON and adopted.

Mr. R. J. MILBOURNE expressed the view that young people entering the Gas Industry ought to think themselves very fortunate having regard to the fine facilities that were provided to-day by which they could advance their technical knowledge, and for the help afforded by membership of the Midland Junior Association. Compared with his early days, the position was very marked, for then technical advancement depended very largely upon individual effort. He was much impressed by the fine spirit which prevailed in the Association, and in referring to the visits to works, expressed the hope that, where necessary, assistance would be given by gas undertakings to their young employees to take advantage of such opportunities.

Features of the New Mossley Gas-Works*

By T. HIBBS, Mossley Corporation Gas Department.

[In view of the fact that a full description of the new Mossley Gas-Works was given in the "JOURNAL" in 1931 (July 1) a few extracts only are taken from a very full and painstaking account of the works prepared by Mr. Hibbs.—Ed., "G.J."]

For coal storage there is a reinforced concrete building 132 ft. long by 42 ft. wide which on one side is connected up to the retort house.

The storage space for coal is on a floor situated 7 ft. 10 in. above ground level. The coal is stored on the floor to a depth of 21 ft. giving a working capacity of 2,700 tons of coal. The floor is designed as a flat slab to carry a superimposed load of 10 cwt. per sq. ft. The columns are spaced at 14 ft. 4 in. centres across the building and at 11 ft. centres along the length of the building. The thickness of the reinforced concrete slab is 10 in. The outside wall columns are 18 in. by 12 in. and the internal columns 18 in. by 18 in. Splayed capitals and drop panels are provided at the top of each column. The centre columns where they occur beneath the division walls are extended as cantilevers to take the horizontal load from the coal store when any particular compartment is loaded and the adjacent one empty.

Full head room is provided for the entire space under the coal stores. In order to separate the various grades and classes of coal four reinforced division walls 13 ft. 5 in. high are arranged across the building, these being further raised to a height of 22 ft. by 9 in. brickwork built in cement. In the lower corner of each of these division walls on the outer side of the coal stores openings 6 ft. by 7 ft. high are formed in the concrete, these being built in with brickwork. Two similar openings, also built in, are formed in the outer concrete wall of the stores. These provisions have been made to facilitate emptying any compartment in case of fire in the store.

The coal feeding band conveyor is supported on the division walls. The walls of the coal stores are of 4 in. reinforced concrete, but on one side and one end a 9-in. brick facing is provided in order that the appearance of the coal stores should harmonize with that of the other buildings.

The roof spans the whole width of the building without any intermediate supports and is an arched construction with ribs and steel tie rods spaced at 11 ft. centres. The height from the ground is 30 ft. and the roof has a rise of 6 ft. 6 in. in the centre. Where the rods come in line with the division walls they have been built in the walls.

For the discharge of coal from stores two 1 ft. 6 in. diameter openings are provided in each bay with built-in cast-iron frames, to which are bolted steel chutes discharging on to rotary table feeders. The lower end of the coal chute is adjustable in height, thus enabling the angle of coal cone to be raised on the table. Cut-off plates are provided to close off coal from any compartment if any alteration to the table is required.

Each table is rotated by a separate motor and the coal is ploughed off by means of an adjustable plate feeding the coal on to a 20-in. rubber band conveyor leading to the gravity bucket conveyor through a movable rotary filler.

By the double control—*i.e.*, angle of cone and position of plough—a very fine adjustment of feed is possible, enabling the pre-arranged proportions of coal giving the desired blend to be closely adhered to.

We attach great importance to the art of blending, enabling as it does the utilization of coals we could not otherwise use. blending our breeze back with caking coals forming the breeze back into coke, varying at will the nature of our coke, leaving, even by high-temperature carbonizing methods, a uniform and sufficiently volatile content in the coke to form an easily ignitable fuel, increasing if desired the gaseous output from the plant, or the gaseous or other product yields per ton of coal, or obtaining the yields from the most economical blends taking values into consideration.

* From a paper before the Manchester and District Junior Gas Association, May 9, 1934.

CARBONIZING PLANT.

All kinds of plants and systems were inspected both at home and abroad. Being in close proximity to the Lancashire and Yorkshire coalfields, enabling us to purchase clean slack coal at a low delivered price, our first tendencies were favourable to horizontal retorts. An examination of tenders revealed that the capital costs of horizontals, continuous verticals, and intermittent verticals were about the same. Labour charges were as low for horizontals as with the other two, while horizontals gave us absolute freedom in the choice of coals and in the matter of repairs and renewals. We came to the conclusion that we could not improve, under our local conditions, on the modern horizontal system with a really up-to-date coke handling plant.

The carbonizing plant consists of a retort bench of seven arches, each arch containing a Drakes' patent regenerator and setting of their latest type. The cubical capacity of the retorts is believed to be the largest in the world. Our observations of the working of the 24 ft. 6 in. long retorts confirm our view that much longer retorts than these can be installed with satisfaction. The settings are constructed in such a manner that we have no difficulty whatever in maintaining a high uniform temperature throughout the length of the retorts and they are easily capable of carbonizing maximum charges in twelve hours.

COKE PLANT.

The handling of hot coke was a problem during the designing of the works. Many installations were visited and many designs were got out, but we were not satisfied with any. It came to Mr. Bennett's notice that a "Le Fleuve" system was in operation at Rouen Gas-Works, and he decided to inspect it. He was highly satisfied with the system as seen. I was instructed to go to Rouen and take observations over a period. I was convinced that it was the best method of coke discharge from the retort house that I had seen, and also the simplest and most economical method of dealing with hot coke.

At the installation at Rouen the coke is pushed into a stream of water in a trough running in front of the retort bench, the hot coke being quenched and carried by the stream to outside the retort house, where it engages with a perforated flight tray conveyor which elevates the coke to a hopper or direct to lorries. From the hopper the coke is taken by a gravity bucket conveyor to the screens and storage hopper. The water drains through the perforations in the flight conveyor and through settling tanks back to the Seine, whence the pumps take the water to the trough.

We thought the system was very good, but there was a certain amount of backwash where the coke and water entered the flight conveyor, and this washed back some of the coke into the tank at the boot of the conveyor and required a man in attendance from time to time.

A conveyor 3 ft. wide was in use for charges which we judged to be 10 to 12 cwt. With the size of retorts we had in view and the speed of discharge, it appeared to us that a conveyor 4 ft. wide would be required. The power needed, as well as the wear and tear, appeared to us a snag in the scheme from our point of view, while we were also desirous of eliminating all outside night work in connection with coke handling—that is, we wanted coke discharged on the night shift to be deposited direct into a hopper to remain there for screening on the day shift along with the coke discharged during the day.

With these points in view, Mr. Bennett designed a modified scheme. The hot coke is discharged from the retorts by means of a Fiddes-Aldridge stoking machine, the bottom two tiers direct, and the upper tiers through a

Harrison type of coke bus (suspended on overhead rails) into a trough. This trough in ferro-concrete is continued on emerging from the retort house through an arc of 90° with a radius of 60 ft. The same fall is maintained outside the building as inside, but the top of the trough is kept level; the trough thus gets deeper as the discharge end is approached. The trough is supported at three intermediate points between the retort house and the coke receiving hopper on a single reinforced concrete column and is covered over with timber decking. Water at the rate of 1,500 gallons per minute is pumped through the trough at the gable end of the retort house.

The hot coke drops on this water and is carried by it along the trough. The steam generated helps to keep the coke buoyant. A steam atmosphere is generated above the coke which helps to steam-quench the exposed hot coke. This is a distinct advantage brought about by covering-in the trough. The speed of the stream is such that from the time of the coke entering the water to being in the receiving hopper is about 10 seconds, so that over-quenching is impossible.

Coke Receiving Hopper.

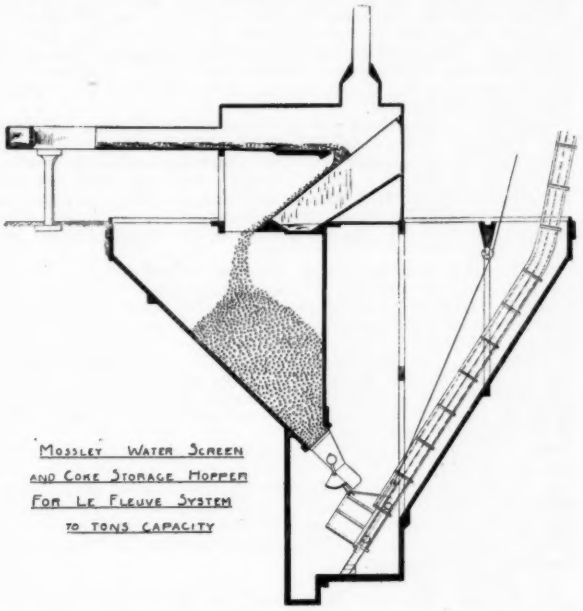
"Le Fleuve" conveyor passes into a reinforced concrete house with chimney where the coke and water are discharged on to an inclined bar screen. To ensure the correct angle of screen, we erected the arrangement in timber and experimented with cold coke from the old works. The spacing we decided upon was $\frac{3}{16}$ in., the angle 36°. In working we find this angle perfect, but, whereas we thought that a less spacing than $\frac{3}{16}$ in. would allow the water to flow down with the coke into the hopper, we have now substituted a $\frac{1}{16}$ in. spacing, and this works very well indeed.

The water which conveys the coke along the trough runs through the screen to a chamber underneath, whence it runs into a first settling tank, then through 18-in. mains through a series of settling tanks to the last tank near the gable end of the retort house, whence it is pumped into the trough for re-circulation.

Fine breeze passing through the $\frac{1}{16}$-in. screen is carried through with the water, and this settles out in the settling tanks which are emptied at periods of from 3 to 6 weeks, the fine breeze thus obtained being blended back with the coal for carbonizing.

The coke slides down the screen into a receiving hopper situated with the top level with the ground. The hopper is 18 ft. at the top with the front face vertical and the other sides sloping down to the discharge opening situated 27 ft. below ground. The hopper collects the coke and has a capacity of 70 tons.

In operation the stoker on the discharge side simply starts the pump and opens the retort doors. The coke is



Mossley Water Screen and Coke Storage Hopper for Le Fleuve System 70 tons capacity

discharged into the stream, and when all coke has been discharged the pump is stopped. This is the end so far as the stoker is concerned.

The coke is in the underground storage hopper quenched ready to be elevated and screened any time during the day. The outside of the coke is quenched, the inside remains red hot and in the storage hopper this hot core drives off the moisture from the outside, leaving a dry coke.

Sheffield Gas Company's Bill

South Yorkshire Gas Grid Scheme

House of Lords Committee—Before Lord Amulree *(Chairman), Lord* Erskine, *Lord* Sandys, *Lord* O'Hagan, *and Lord* Swinfen.

Thursday, May 10 (*continued from p.* 405).

Mr. Henderson asked if the Company was quoting for the supply of crude gas to the industrial community of Sheffield generally.

Col. *Stephenson* replied that it was not, but that it was selling purified gas at crude gas prices.

Mr. Henderson challenged that, and he quoted from a printed notice indicating that the Rotherham Gas Undertaking was offering crude gas at 7½d. per 1,000 c.ft. (1½d. per therm); the difference between that price and 1s. per 1,000 (which was the price charged for purified gas in Sheffield for quantities below 100 million c.ft. per annum) might make all the difference between taking a supply from the Company and making producer gas. The very lowest price for purified gas from the mains was 10d. per 1,000 c.ft., and then the consumption must be more than 100 million c.ft. per annum. He said that the gas which the Tinsley Wire Works were taking from the United Steel Company was crude gas, a commodity which the Sheffield Company did not supply within its limits except where a pipe happened to pass the door.

Col. *Stephenson* did not think that was a fair conclusion. It might be true to-day, but it might not be true to-morrow. The Company was supplying crude gas to-day in circumstances in which it would be able to supply the Tinsley Wire Works. The reason those works were obtaining gas more cheaply than the Sheffield Gas Company could supply it was not that it was crude gas, but merely that the main from the colliery was a short length and the capital charges were small.

Mr. Henderson then pointed out that the low-temperature carbonization industry might expand, and a plant might be set up in the Company's limits, and produce coke oven gas as a bye-product. The Sheffield Gas Company would be forbidden to buy it from them, because it could only buy from the Grid Company; yet, if this Bill were passed, the producers could not sell it elsewhere, and could only sell it to the Gas Company if they joined the Grid Company. So that the effect of the Bill would be to compel people to become members of the Grid Company, which was essentially a voluntary combination.

Col. *Stephenson* agreed, but said that this was purely hypothesis and was far-fetched.

Mr. Henderson added that, if they joined the Grid Company, there was still no guarantee that the Sheffield Company would want their gas.

The Committee then adjourned until Friday, May 11.

Friday, May 11.

Mr. *Ralph Halkett*, General Manager and Secretary of the Sheffield Gas Company, was next called, and generally confirmed the evidence given by Lieut.-Col. Stephenson, the Chairman of the Company. Mr. Halkett in the course of further evidence said he had laid 29 miles of mains to bring coke oven gas to the Sheffield Company, and, he added, the purchase of coke oven gas had been the greatest factor in the Company's ability to reduce prices all round. To-day, the Company's basic price was 7d. per therm, and, with the exception of Bath, it was the cheapest rate charged anywhere in the country. The total capacity of the Sheffield Company's works was 29 million c.ft. per day, and there was storage capacity for 21 millions. The area of supply was at the present time 147 square miles, in which 938 miles of mains had been laid with a view to supplying every possible consumer. At the end of 1933 the total capital expenditure amounted to £1,628,846. Speaking of the arrangement come to with the South Yorkshire Gas Grid Company, Mr. Halkett said the agreement with that Company had enabled that concern to fix a minimum price, for which, however, there would have been no security except for the agreement. In 1931 there was no other outlet for the coke oven gas except in Sheffield, and the whole of the coke oven gas at present available could be consumed in Sheffield. Discussing

the negotiations and discussions that had taken place with United Steel Companies, Ltd., witness said he had never heard it suggested by that Company that it held itself free to compete with the Sheffield Gas Company; and referring to the Yorkshire Grid, he told the Committee that this had not yet been a success so far as the Sheffield Company was concerned, because, since cheap coke oven gas had been supplied, the dividend paid by the Sheffield Company had been reduced by ¼%. At the same time he accepted the view that it would take two or three years for the grid scheme to get into full working operation. Nevertheless, had the Sheffield Company appreciated that the coke oven owners would endeavour to compete with the Company in the Sheffield area, it would never have undertaken the grid scheme.

Replying to questions put in cross-examination on behalf of the Yorkshire Power Company, Mr. Halkett emphasized the point that at the present time that Company had no generating station in the Sheffield Gas Company's area and therefore was not affected by the Bill. This opposition, he said, was based on a remote possibility that the Company at some future time might want to erect a power station in the Sheffield Gas Company's area.

Sir LYNDEN MACASSEY, K.C., cross-examined at some length on behalf of the South Yorkshire Gas Grid Company, and pressed Mr. Halkett with questions as to what the Sheffield Gas Company had done to promote the sale of crude coke oven gas for industrial purposes. The reply was that the Sheffield Gas Company had developed the sale of gas generally throughout its area, as was to be seen in the increased sales of gas, and Mr. Halkett said it did not matter whether the gas was crude or purified. The sales were increasing due to the efforts of the Sheffield Company.

Sir LYNDEN MACASSEY remarked that that was not what the agreement said.

In further questions, Sir Lynden Macassey called attention to the fact that Mr. Halkett was on the Boards of three companies concerned with the coke oven industry in the district—one being a colliery—presumably to watch over the interests of the Sheffield Gas Company.

Mr. *Halkett* agreed.

Sir LYNDEN MACASSEY then asked whether Mr. Halkett had ever suggested to either or all of those three companies that there should be agreements between every single one of the constituent companies of the Grid Company.

Mr. *Halkett* said he had not. He added that the whole policy of the Sheffield Gas Company had been to maintain as friendly relations with the Grid Company as possible and it had been the desire not to put any obstacles in the way, because he knew there were difficulties with the members of the Grid Company, and they could only be overcome by maintaining the best of feelings.

Some questions were then put by Mr. THOMAS, K.C., for the Mining Association of Great Britain, and he suggested that the Bill altered in fundamental aspects the position of numbers of people who were not members of the Grid Company who had never had any contractual relations with the Sheffield Company.

Mr. *Halkett* replied that his contention was that these people, who were outside the Sheffield Gas Company's area, should not be allowed to compete in the Sheffield Gas Company's area. Such people should become members of the Grid Company and not endeavour to defeat the whole object of the grid scheme.

Mr. THOMAS retorted that at the present time these people could supply their surplus coke oven gas to others if they could do so without breaking up the streets.

Mr. *Halkett* pointed out that it would be difficult to get far into the area of the Sheffield Gas Company without the necessity for breaking up the streets, and that therefore these people were not being injured by what was proposed in the Bill.

Cross-examination on behalf of the National Association of Coke and Bye-Product Oven Owners followed by Mr. Jacques Abady. He put it to witness that the Sheffield Gas Company was still free to erect further gas-works in Sheffield if it so desired, and that it had received considerable advantages in reduced maintenance of works and in other ways by taking such a large proportion of the gas it supplied in its area in the form of coke oven gas.

Mr. *Halkett* said that if the Company had contemplated being compelled to erect additional gas-works of its own it would never have spent the amount of money it had done on the grid scheme.

The Committee adjourned.

Monday, May 14.

The greater part of Monday was devoted to the further cross-examination of Mr. Halkett by the various opponents.

A point raised by Mr. W. CRAIG HENDERSON, K.C., on behalf of the Yorkshire Electric Power Company, was that of competition between gas and electricity as industrial power, in which connection he mentioned electric furnaces; and he also objected that if the Bill were passed the effect would be that the electrical industry could only buy coke oven gas from its trade competitor, at the trade competitor's price. Mr. Halkett agreed that that was so within the Gas Company's limits of supply. With regard to electric furnaces, he would not agree that they could compete with gas in the industrial field, and he held that they played a small part in the district for steel work.

Another suggestion was that if the Gas Company extended its limits of supply in the future it would wish to apply to the extended area the principle of the present Bill. Mr. Halkett, however, would only say that that matter had not been considered.

On behalf of the United Steel Company, Mr. Henderson referred to the supply of coke oven gas to the Tinsley Wire Works, and pointed out that, as the result of tariffs, it had become practicable to construct works there, bringing to this country a new industry. The Tinsley Wire Works were making wire netting, he said, which was previously imported from abroad. He supposed there was no objection to that.

Mr. Halkett, however, would not go so far as to say that it was a new industry, for there were wire industries there before tariffs were imposed; but additional works had been brought to Sheffield.

Questioned with regard to the attempts to renew the agreement existing previously for a supply of coke oven gas from the United Steel Company to the Sheffield Gas Company, Mr. Halkett said that conferences were held in 1932, and the difficulty was always one of price; the 6½d. per 1,000 c.ft. offered was considered by the Steel Company to be too low. Subject to agreement as to price, the Sheffield Company would take the gas to-morrow.

A great many questions were put to witness by Mr. W. E. Tyldesley Jones, K.C., in the course of re-examination, it being stated that at the time of the conferences it was not suggested that the United Steel Company was considering the sale of its surplus coke oven gas to other people, but rather its use by a works in Rotherham belonging to the Steel Company, and situated without the Gas Company's area of supply. If that had not been suggested, the Gas Company had been prepared to take the whole of the Company's surplus gas. Counsel said that Mr. Benton Jones, of the United Steel Company, had stipulated for a better price for his own Company's gas than he had agreed to for the whole of the Grid Company.

As to the use of coke oven gas by the Yorkshire Electric Power Company, Mr. Halkett agreed that that Company could not afford to pay 5½d. per 1,000 c.ft. for gas to be burned under boilers. He agreed with Counsel's statement, however, that, on the other hand, unless a good price were paid to the coke oven owners they would not derive much benefit, and that the object of the grid was to enable the coke oven owners to sell gas at a remunerative price and not at a starvation price which the Electric Power Company could afford to give. Again, said Counsel, if there had been no grid agreement, the Gas Company would not have been compelled to pay 5½d. per 1,000 c.ft., but would have been able to play off one coke oven owner against another, and might have been able to buy at the same starvation price as the Yorkshire Electric Power Company. The scheme, however, guaranteed the coke oven owners 5½d. per 1,000 c.ft. for their surplus gas, and, inasmuch as the competition of the Gas Company in the coke market was removed, it gave the coke oven owners a more stable market for their coke, in so far as it was to be used for domestic purposes.

Questions were asked by the Chairman as to whether the price of 5½d. per 1,000 c.ft., paid to the Grid Company, was dependent on a particular price for coal; Mr. Halkett replied that it was, and that the gas price varied as the price of coal varied.

After references had been made to the United Steel Company as being the only constituent member of the Grid Company who had not "played the game" concerning the making of agreements for the sale of gas to the grid—so far as the Gas Company knew—Counsel said it seemed to be thought by the opponents that some manufacturers preferred to use crude gas rather than purifier gas. Their whole purpose, however, was one of price, and he emphasized that, whereas a consumer whose works were near a crude gas main could obtain a supply from it, the works of another consumer might be some distance from it, and the cost of laying a special main to give him a supply of crude gas might be greater than the cost of purifying and supplying through the existing distributing mains.

To all this Mr. Halkett agreed.

Lieut.-Col. Stephenson was re-called for further cross-examination.

Tuesday, May 15.

Though it was expected that Mr. A. W. White (of Messrs. Cash, Stone, & Co., Chartered Accountants) would give evidence for the promoters, relating to the negotiations with the coke oven owners in 1931, Counsel intimated on Tuesday morning that, there having been no cross-examination on the evidence already given on that matter, there was no point in calling further evidence.

OPPOSITION OF THE COKE OVEN OWNERS.

Mr. JACQUES ABADY, addressing the Committee on behalf of the National Association of Coke Oven and Bye-Product Plant Owners, said their major interest was to prevent anything being put on to the Statute Book, in a Private Act, which might prejudice existing or future coke oven owners either in South Yorkshire or other parts of the country. After pointing out that the coke ovens of the country carbonized about 14 million tons of coal and produced from 9 to 9½ million tons of coke per annum, he emphasized that the products of coke ovens depended on the steel industry's demand for coke, and not upon the ability of the Gas Industry to absorb the gas. The purpose of the Area Gas Committee was to find a means of utilizing the gas produced when there was a large demand for coke, and there was nothing in the Committee's report indicating the intention to limit the effective use which coke oven owners could make of the gas they produced. The Gas

Company had made a great parade of the Committee's report, as though it were sacred and binding; but in no sense could it be said that the Acts of the Sheffield Gas Company carried out the suggestions made in the report. The present Committee had not to consider now the report of the Departmental Committee; it had to consider that Parliament had given the Sheffield Gas Company certain powers, and whether there was sufficient justification now to amend those powers so as to deprive private citizens of the private rights they possessed to deal with their own property. The Committee was being asked in effect to amend—and this had not yet been mentioned—a provision in the Gas Company's 1931 Act which was inserted expressly to preserve the rights of the coke oven owners. If the coke oven owners were compelled to sell their gas only to statutory gas undertakers, those undertakers could make what bargain they liked, so that in the end the coke oven owners would be no better off than they were before. Whilst he was not seeking to belittle the work of the Sheffield Gas Company or to suggest that they were not good business men, he did say that the very structure of the Company and the powers they possessed were not consistent with making the full use of coke oven gas, and that the full use of this gas could be interfered with most seriously if the Bill were passed.

By their Act of 1929, the Company were empowered to buy coke oven gas and convert it for their own supplies through their ordinary gas distribution system, or to lay mains and supply coke oven gas separately as such for industrial use by agreement, in which latter case they were free from the restrictions applying to their ordinary supplies in respect of calorific value, purity, pressure, testing, or price. They had been able, as a business proposition, and no doubt a good business proposition, to buy the gas merely to sell it, not as coke oven gas, but as ordinary town gas, but otherwise they were not taking any steps whatever to enable the surplus coke oven gas in the neighbourhood to be used for industrial purposes. They had not laid any mains for the distribution of coke oven gas.

Mains had been laid, under the provisions of the Company's 1929 Act, to convey coke oven gas in bulk to the Sheffield Gas Company; but by the Act of 1931 the mains through which the Company took this gas were deliberately excluded from whatever control there might be under that Act; so that those mains were and would remain for all time the private property of the Company, not put down for the purpose of utilizing coke oven gas in any sense recommended by the Area Committee's report, but to enable the Company to buy coke oven gas for their own gain. The coke oven gas network scheme pre-supposed that there should be a separate business of coke oven gas supply; but there was no separate coke oven gas supply business because there were no separate mains for the supply of coke oven gas. The system which the Company had put in hand was diametrically opposed to any idea of distributing coke oven gas as such in a large and wholesale way at the lowest possible charge and debiting against it the minimum of charges—*i.e.*, only those which were strictly applicable to it.

Counsel contended that a section of the Company's 1931 Act indicated the intention that coke oven owners should have freedom to make contracts for the supply of coke oven gas; and in the name of common sense there should be that freedom. The Sheffield Gas Company could take coke oven gas only according to the extent of their consumers' demands for gas; the production of the coke oven gas, however, depended on the demand of the steel industry for coke. The two things did not synchronize, and it must have been intended by the 1931 Act that coke oven owners should be free to dispose of their gas. Further, if the Sheffield Gas Company had contracted for all the gas they could possibly sell, what possible harm could be done to them if the coke owners were free to sell coke oven gas as such—in default of the Gas Company, not having done so—in the manner they had done before? The effect of the passing of this Bill would be to repeal the section of the 1931 Act which gave the coke owners the freedom to make contracts, and which was inserted in their interests. It was not in the public interest that anybody who wished to obtain large quantities of coke oven gas as such, and at such pressures as might be convenient, should be precluded from buying gas except that which dribbled through the mains of he Sheffield Gas Company at 3-in. pressure. If the Bill were passed it would be used as a precedent in other directions. Disputes about contracts should be settled by agreement or arbitration. To put on the Statute Book a clause which fettered the personal rights of a number of people, and which might easily be very detrimental to important industries, was the veriest example of breaking a butterfly on a wheel.

Col. *H. Sprot*, B.A. (a Director of Messrs. Sir A. Sadler, Ltd., proprietors of collieries and coking and bye-product plants in the Durham district), gave evidence against the Bill, on behalf of the National Association of Coke Oven and Bye-Product Plant Owners. He said that his Company supplied gas to other undertakings, and supplied certain districts with gas for all purposes. At a meeting of the Association, held last January, a resolution to petition against the Bill was carried unanimously, on the ground that the principle sought to be established was of grave importance, entirely in favour of the Gas Industry, and to the detriment of the coking and bye-product industry. With the anticipated improvement in the steel industry, more coke and gas would be produced, and the Association was anxious that no possible avenue for the sale of that gas should be blocked.

In the course of cross-examination by Mr. J. H. Thorpe (for the Sheffield Gas Company) witness agreed that if he were offered purified and unpurified gas at the same price he would take the purified gas; and he agreed also that he would be lucky to get it as cheap as the purified gas.

The Yorkshire Electric Power Company's Case.

Mr. *W. B. Woodhouse* (General Manager of the Yorkshire Electric Power Company, a Director of the Yorkshire Waste Heat Company, Ltd. (whose capital is held by the Power Company), and a Past-President of the Institution of Electrical Engineers) gave evidence. He had made a special study, he said, of fuel problems, and had been a member of the Fuel Economy Committee of the British Association, and of a Committee of the Mining Association dealing with the same subject.

Powers were possessed by the Yorkshire Electric Power Company to acquire collieries and other works which might be necessary in connection with the production and supply of electricity, and coke oven gas was one of the fuels with which it was authorized to deal. The Company was also authorized to hold shares in or to lend money to any company agreeing to give them a supply of gas, waste heat, and other forms of energy. The generating station belonging to the Company at Barugh was utilizing coke oven gas supplied from the coke ovens of the old Silkstone collieries, and supplies of gas were also obtained from other companies; various plants had been put up near that station, one of the conditions being that the station would take the gas. One of the Company's problems had been to find means of co-operating with the collieries in using surplus low-grade fuels, and the fact that the Company could use the surplus gas was a strong inducement to the collieries to use electric power. The coke oven owners supplied to the Power Company all the gas they had to sell; as their own load varied and their own requirements decreased, they supplied more to the electricity station, and *vice versa*. On the other hand, when the Sheffield Gas Company were buying coke oven gas it was supplied only in accordance with their requirements. If the Power Company had a station within the limits of supply of the Sheffield Gas Company, it would be prohibited from making arrangements with collieries for supplies of coke oven gas, without the consent of the Gas Company. Coke oven gas was being used by a large number of electricity undertakers in Yorkshire, and if the principle of the present Bill were extended to other areas the result would be serious. There were 1,844 coke ovens in the Power Company's area of supply, producing a quantity of surplus gas equivalent in heat value to about 400,000 tons of coal per annum. It was only by co-operation between the electricity interests and the collieries that the most economical use of this gas could be effected.

Of the 18 constituent members of the South Yorkshire Gas Grid Company, the Power Company had already made agreements with 11, and were negotiating with others, either for the purpose of supplying electricity to them or taking electricity from them, or putting down electricity plants and using the surplus gas on the spot. If the present Bill were passed, it would still be open to the colliery owners to make electricity and sell it to the Power Company; a more favourable arrangement could be made, however, if the Power Company provided the machinery, but the utilization of the coke oven gas by the Power Company would be prohibited.

Mr. Tyldesley Jones (for the Gas Company), cross-examining, asked if witness was in favour of a gas grid.

Witness replied that if the capital expenditure could be justified, co-operation was a good thing. But he was much more in favour of getting rid of the small batteries of coke ovens and concentrating them in a situation where the best possible use could be made of their products, one use being the production of electricity.

Counsel said he gathered witness was not in favour of a gas grid.

In reply to further questions it was stated that the price paid last year for coke oven gas used at the Barugh station was a little under 2d. per 1,000 c.ft. Counsel also emphasized that the two most efficient generating station extensions in the area were using slack fuel, and not coke oven gas.

Asked if he welcomed competition, witness said he deprecated it in distribution because that meant duplicating distribution mains, in the case of either gas or electricity.

Evidence for the United Steel Companies.

Mr. *W. Benton Jones* (Chairman of the United Steel Companies, Ltd., Chairman of the South Yorkshire Coalowners' Association, a Vice-President of the Mining Association, and a Director of the South Yorkshire Gas Grid Company), who next gave evidence, said that the United Steel Companies, Ltd., was a large composite undertaking, having a share and loan capital of about £10,000,000, and employing 25,000 men. It produced steel, iron, pig iron, coke, and coal, either directly or through subsidiary companies owned by it, its production of steel per annum being 1,325,000 tons. It carbonized annually about 1 million tons of coal, which he believed was greater than the quantity carbonized by any gas undertakings, apart from the two big London undertakings. His Company was opposing the Bill because it was opposed to a monopoly in the supply of gas by one person or corporation which restricted the freedom of large producers of gas to use it in their own works or allied works for manufacturing their products. A good deal of rationalization was going on in the iron and steel industry, and there might be more, and his Company wished to be free to supply its own and allied works with the gas it produced. He did not consider that membership of the Gas Grid Company was inconsistent with that policy, in so far as it enabled his Company to dispose of any gas which it did not want for its own

purposes or the purposes of those undertakings with which it was allied; in the disposal of the surplus gas his Company would desire to act in co-operation with others.

Discussing his conversations with the Gas Company's representatives, he said he was offered 6½d. per 1,000 c.ft. After careful consideration he had concluded that it would be more economical to supply his own Company's associated works—Messrs. Steel, Peech, & Tozer.

With regard to the supply to the Tinsley Wire Works, it had been concluded there that, rather than use town gas, it would be better to incur the capital expenditure on installing producers and use producer gas. He was told that the representatives of the Tinsley Wire Works were under the impression that they could not obtain gas from any other source than the Sheffield Gas Company, but he had pointed out that there was nothing to prevent them having a supply of coke oven gas from the United Steel Companies' plant. He had regarded it as a matter of courtesy to inform the Gas Company of what had been done.

Cross-examined by Mr. Tyldesley Jones, witness agreed that his evidence before the Area Gas Committee had been in favour of the grid, because it was a step in the organization of the coking industry; it would be a means of avoiding competition between the coke oven owners, and would enable them to deliver gas to gas consumers.

With regard to the South Yorkshire Gas Network Bill, which was promoted in 1931, but was dropped in favour of the Sheffield Gas Company's Bill, Counsel said that that proposed to confer upon the Grid Company power to construct a network to take the gas surplus to the requirements of the owners of the coking plants, and distribute it to users. The effect of the provisions of that Bill was that there was to be no competition between the Grid Company and an authorized undertaker, such as the Sheffield Gas Company, without the consent of that undertaker, and there was provision that the Board of Trade was to decide, in case of dispute, whether or not an authorized undertaker had unreasonably withheld consent. That was the proposal of the promoters of the Bill, one of them being United Steel Companies.

Counsel said that never at any stage had witness made the slightest suggestion to the Gas Company that the coke oven owners would hold themselves free to supply gas in competition with the Gas Company. Witness agreed that he did not.

In reply to further questions, he said his Company had made it clear to its colleagues in the Grid Company that it must reserve the right to use its own gas in its own works or in works in which it was interested, and the understanding existed that the other companies should be in the same position.

COUNSEL asked if there were any document containing that reservation.

Witness said there was a form of agreement between members of the Grid Company which referred to allied industries. In his view it carried out the suggestion. His Company had not signed the agreement, one reason being that at the time the Grid Company was formed his Company was already supplying gas to the Sheffield Company.

COUNSEL asked if witness contemplated that his Company should keep its hands free so that it might get the best price for any gas it was able to sell, notwithstanding that others might be bound.

Witness said he did not.

COUNSEL said United Steel Companies was free, and was not even bound subject to the reservation referred to.

Witness, while agreeing that the Company had not signed the agreement, was of opinion that, even if it had, it would still be free to supply its own or allied works.

A number of questions were asked by Counsel as to whether the reservation referred to was incorporated in some document drawn up in 1931, having regard to its importance, but witness said that he knew of no such document.

Wednesday, May 16.

Resuming his cross-examination of Mr. Benton Jones, Counsel pointed out that if there had been no grid the Sheffield Gas Company could have made contracts with individual coke oven owners, and could have afforded to pay a higher price for gas produced in or near their limits of supply than for gas produced at a distance, by reason of the difference in the capital charges on the mains, due to the difference in their length. The uniform price arrangement, therefore, inured to the benefit of the coke oven owners, and prevented haggling and competition.

Mr. *Benton Jones* agreed that it was of advantage to have an averaging arrangement if the price were sufficiently high.

Counsel's retort to this was that the Rotherham Corporation, who had opposed the Gas Company's Bill in 1931, had said that the price arranged to be paid by the Sheffield Gas Company for the coke oven gas was too high.

Questions were then asked as to why it was necessary to make the reservation that the United Steel Companies should be free to use its surplus gas in its own or allied works, Counsel having first obtained from witness the view that even if that reservation were not made the Company would not have been bound to supply its gas to the grid. Counsel contended that the purpose of making the reservation must be to limit the obligations that otherwise would be incurred. Witness replied that his Company was a large producer of coke oven gas, and had potentialities for its use greatly in excess of those of the ordinary coking plant. The reservation was made from the beginning of the discussions in order to make it plain that the Company was in a different position from its partners in the Grid Company, because, whereas they might have the whole of their gas for disposal, his Company would have available only the quantity which it did not require in its own works or in those undertakings allied to it.

It was put to witness that it was of the utmost importance to those who were running the grid to know how much gas was likely to be available; but he did not agree, because mains would not be laid until they were satisfied that the gas would be supplied to it.

COUNSEL then asked whether, if three or four coke oven owners were willing to sell gas—as they had been—and the Gas Company constructed the grid and took the gas, it would be fair for the coke oven owners subsequently to terminate the agreement, to construct a grid parallel to that of the Gas Company, and to supply gas to the latter's consumers in Sheffield.

Witness replied that it would not be fair; but neither would it be practicable.

COUNSEL asked whether, until September, 1933, witness had suggested to the Sheffield Gas Company that he considered his Company free to lay mains and convey gas into the Gas Company's limits, and supply in competition.

Witness replied that he did not think so, and he saw no reason why he should have done.

Attention was then directed to the negotiations concerning the supply of gas to the Tinsley Wire Works by the United Steel Companies.

Witness said he had been told that the Wire Works had been discussing with the Gas Company terms for a supply of gas, but were satisfied that such a supply would cost more than would producer gas made on the works. He admitted that he had not inquired into those prices, but he had told them that the Steel Company had the right to supply. It was true that subsequently he had called on Mr. Halkett (General Manager and Secretary of the Gas Company), because he had always carried out arrangements with the Gas Company.

COUNSEL: You went to "break it" to Mr. Halkett that you were going into his limits of supply?

Witness: I went to tell him.

Further questions brought out the statement that three of the constituent members of the Grid Company had made agreements for the supply of a certain quantity of gas to the Grid Company, but only one or two, or maybe three, of the constituent members had *not* made agreements to hold gas at the disposal of the Grid Company. Counsel commented that two of those who had not made agreements were the United Steel Companies and Messrs. Samuel Fox, but witness said that the latter Company had no gas available, for it was all used on the works or supplied to the Stocksbridge Gas Company, which they owned.

A good deal of discussion centred around the definition of the word "allied," and witness defined an allied undertaking as one in which another might have a small financial interest, or of whom it might be the landlord or lessee, and in whom it was interested commercially for the interchange of products. He agreed that that was a very wide definition; but Counsel went further and suggested that there were very few companies in the South Yorkshire area which might not fall within some part of it.

Witness added that there was a definition in the agreements between the constituent companies and the Grid Company.

ADDRESS ON BEHALF OF THE UNITED STEEL COMPANIES.

Addressing the Committee on behalf of United Steel Companies, Mr. CRAIG HENDERSON contended that the report of the Area Gas Committee had nothing whatever to do with this case, although the Sheffield Gas Company's Act of 1931 had been constantly linked with it throughout these proceedings. In his view the evidence showed that it was clearly understood by Mr. Halkett that it was within the agreement between the Gas Company and the Grid Company that any of the individual companies could sell coke oven gas individually, and such action had never been suggested as illegal or contrary to the agreement. After all, the scheme embodied in the Sheffield Gas Company's Act of 1931 was to sell crude coke oven gas for industrial purposes, but the Company did not supply any crude coke oven gas; it purified all the coke oven gas it received, and, in fact, had changed completely over from supplying coal gas to supplying coke oven gas in a purified form throughout its whole area. The position of the United Steel Companies, Ltd., was that endeavours were being made to rationalize the iron and steel and allied industries, and the supply of cheap crude coke oven gas between the works of the Company was one of the most important steps in that process. United Steel Companies had interests, financial and otherwise, in many companies using its products, and yet by the terms of the Bill it was to be prohibited from supplying crude coke oven gas made in one works to another of its own works which could use the gas in its manufacturing processes.

Counsel recalled that Mr. Benton Jones had stipulated in the agreement between the Grid Company and the Sheffield Gas Company that he was to be free to supply gas to any company in which he was interested, and others in the area took the same view as Mr. Benton Jones. To place the industries of this district in the position of having to apply to the Sheffield Gas Company for their supplies of coke oven gas when in all probability the Gas Company had no main in the particular neighbourhood would create a position that the Gas Company could impose such terms as would constitute a tax on industry, because the Company would be under no obligation to supply, whereas the industries were compelled to apply only to the Sheffield Gas Company. Moreover, the Bill as originally lodged was a veto on "supply," and it was his contention that in giving

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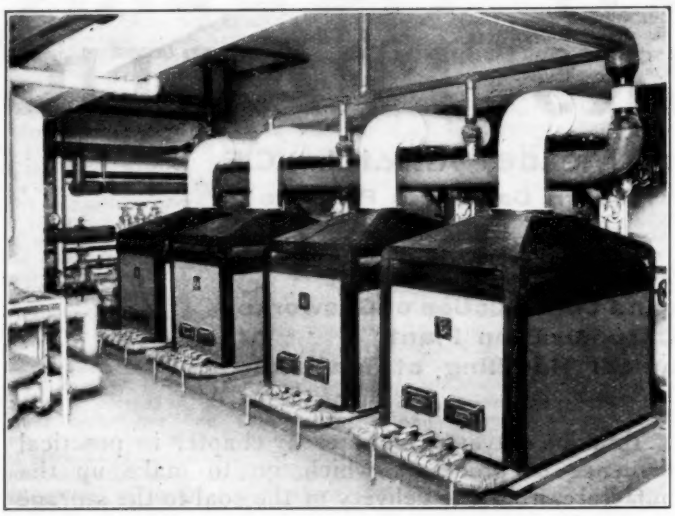

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a supply as between different works of the same undertaking the particular company did not "supply;" but the Bill had since been amended to bring this within the definition of "supply," thus making it clear that a Company like United Steel Companies, Ltd., could not pass on its own gas to its own works without the consent of the Sheffield Gas Company. That modification of the Bill entitled him, said Mr. Craig Henderson, to raise objections on Standing Orders in the other House. The whole principle of the Bill was unprecedented, and from the point of view of one of the constituent companies of the Grid Company he asked the Committee not to allow it to go forward.

Speaking on behalf of the Yorkshire Electric Power Company, Mr. Craig Henderson impressed upon the Committee that this Company already used very cheap coke oven gas, but if the Bill were passed the Company would only be able to get a supply from its chief competitor, which could either refuse to give a supply or impose a price equal to the price of town gas.

Mr. F. G. THOMAS, K.C., for the Mining Association of Great Britain, followed on similar lines with regard to the general aspect of the proposals of the Bill, and said that had it not been for the quarrel between the Sheffield Gas Company and United Steel Companies, Ltd., it would never have been promoted. He contended that the other aspect of the proposals—viz., the veto given to the Sheffield Gas Company concerning the supply of coke oven gas in the area—was of far greater importance than the long discussions there had been as to negotiations between the Gas Company and the United Steel Companies; and surely the general law should not be altered at the instance of the Sheffield Gas Company because it desired to ventilate what it felt was a grievance. If the Committee felt the principle involved in the Bill was a good one, then it was a matter for general legislation by Parliament and not for piecemeal legislation in an individual Private Bill. The strongest objection was taken by the Mining Association to the prohibition placed upon a coke oven gas to affiliated works. Moreover, the curious position would arise, if the Bill was passed, that, while nobody could supply coke oven gas without the consent of the Sheffield Gas Company, they could supply town gas or producer gas in so far as it was equally possible to do so.

Sir LYNDEN MACASSEY, K.C., on behalf of the South Yorkshire Gas Grid Company, said the Committee had been involuntary spectators of a highly spectacular squabble between Mr. Halkett and Mr. Benton Jones, but the Grid Company was not concerned with that squabble in any way, and would not now be concerned with it but for the fact that the Sheffield Gas Company was endeavouring to place itself in a position of uncontrolled monopoly, a wholly unprecedented thing, and a clear breach of the agreement between the Grid Company and the Sheffield Gas Company.

Thursday, May 17.

Continuing his address, Sir Lynden urged that if the Bill were passed it would impose a disability on industry at a time when no obstacles should be placed in the way of trade recovery. No special circumstances could be suggested for placing the Gas Company in a position of unparalleled privilege as compared with that of other gas undertakings in the United Kingdom. The case in support of it was rather like an inverted pyramid, balancing on its apex. It had been contended that the provision in this Bill was something which had been agreed upon with the Grid Company and its constituent members in 1931, but that, inasmuch as the formal agreement did not include it, that agreement should be rectified, and the Bill would have that effect. Counsel emphasized, however, that when the Courts rectified an agreement they rectified an agreement as between the original parties to it; but the present proposal went further than that, for it brought in coke oven owners who were not constituent members of the Grid Company, or who in the future might construct coke ovens in this area. Then, in order to meet that obvious criticism, the promoters had fallen back upon the argument of public policy, and asked that they should be constituted the sole monopolists for the supply of gas in their area. They asked that they should be entitled to prevent an industrialist supplying his own coke oven gas to his own works (if they happened to be separated from the coke oven plant by even a road, a railway, or a canal), or to associated or allied works unless they adjoined the coke oven plant. In addition to that, the Gas Company were not bound to supply coke oven gas as such, and could refuse to supply it if they wished; they were not restricted as to the price they charged, and they could impose conditions of supply. Their proposition was just about as bold as any put forward in the Parliamentary Committee rooms. It raised grave questions of public policy. Col. Stephenson and Mr. Halkett were as acute business men as had appeared before any Committee of Parliament. No Court of Law would consider the proposition for a single moment. It would be extremely unjust that one party to an agreement should be held bound to it while that agreement was altered for the benefit of the other party—*i.e.*, the Gas Company. He believed the Committee would draw the inference that no coke oven owner would, either directly or through the Grid Company, have been a party to the agreement in 1931 if he had understood that there would be imposed on him the disability against using his own gas except on the land on which it was produced, or on adjoining land, if the works happened to be in the Sheffield Company's area.

Mr. TYLDESLEY JONES said the evidence was that some of the constituent members of the Grid Company were satisfied with the terms of the Bill. He also pointed out that in 1931 there were no coke ovens within the Company's limits of supply.

Sir LYNDEN MACASSEY replied that that fact made his point all the stronger. He contended that there was no understanding such as has been suggested between the Gas Company and the Grid Company.

It was perfectly clear from the evidence given before the Area Gas Committee, and it should have become equally clear from any unbiassed consideration of the circumstances of this case, that the only means of making a success of a gas grid scheme was to ensure full co-operation. To substitute for that general co-operation of the coke oven owners a condition of things whereby they were placed under this most onerous disability in favour of the Gas Company would wreck the scheme, and Parliament would do a serious disservice to industry if it acceded to the Gas Company's proposition that they should be given the uncontrolled monopoly provided for in the Bill.

At the conclusion of Sir Lynden's speech, the Committee deliberated in private for a considerable time. All that happened after the re-admission of the parties, however, was a discussion as to the Committee's future proceedings. The CHAIRMAN (Lord Amulree) said the Committee realized the importance of the principle underlying the Bill; that was why they had been so indulgent in hearing the parties at such length, and they did not wish to circumscribe the promoters' Counsel in any way in his summing up.

Trade Notes.

Intermittent Vertical Chamber Plant for Stalybridge.

Gas Chambers and Coke Ovens, Ltd., of Abertillery House, London, S.W. 1, have received a contract from the Stalybridge Gas Department for an installation of intermittent vertical chambers integral with a three-compartment coke dry cooling plant of the Collin type and embodying coal handling and blending plants and waste-heat boilers.

Gas Companies' Results in 1933.

Haywards Heath.

During the year 1933 the Haywards Heath District Gas Company experienced a slight decrease of 1·38% in the sales of gas compared with 1932. The total quantity sold amounted to 127 million c.ft., as against 129 millions. The balance at the credit of profit and loss account was £6,403, and the Directors recommended a final dividend at the rate of £10% per annum on the 5% consolidated stock for the half-year to Dec. 31, 1933, making £9%, less income-tax, for the year. The balance to be carried forward amounts to £4,569. During the past year new condensers, washer, and purifier have been installed. A larger high-pressure main has been laid to Balcombe and a new main laid at Cuckfield. New property has also been acquired for the purpose of converting to more spacious showrooms and offices. It is understood that for the first three months of the present year gas sales show an increase of 5·05% over the same period of last year.

Gas Acts (1920 and 1929) Orders.

DECLARATION OF CALORIFIC VALUE.

Halesowen Gas Company.

The Company give notice that, as from Sept. 1, they will supply gas of 475 B.Th.U. This date is in substitution for July, as formerly announced.

SPECIAL ORDER.

Bournemouth Gas and Water Company.

In connection with the scheme detailed in the "JOURNAL" dated May 16 (p. 402), the Company intend to apply to the Board of Trade for a Special Order authorizing them to purchase the undertakings of the Lymington Gas and Coke Company, Ltd., and the Ringwood Gas Light and Coke Company, Ltd.

GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

Business on the Stock Exchange last week was restricted by holiday influences and by the fact that it was the middle of a three-week Account, which is usually an unpopular period. Prices, however, remained steady, and a renewal of activity, especially in the new issue market, is anticipated in the near future.

The Gas Market was by no means idle. A large volume of business was recorded in Gas Light units and Imperial Continental, while other leading stocks were also well supported. Prices continued to harden, and a notable increase was that of Oriental ordinary with a gain of 5 points to 157½, which compares with 116½ a year ago. It will be remembered that this Company's accounts for the year to June last showed a very satisfactory financial position, and enabled the Directors to pay a final dividend of 9% per annum free of tax (against 9% per annum, less tax, for the previous year). The current interim dividend of 7% per annum is also being paid free of tax, and on the basis of 8%, free of tax, for the year the yield at the current price works out at £6 11s.%.

The accounts of the Imperial Continental Gas Association for the year to March 31 last show a net profit, after allowing for income-tax, of £514,269 (against £510,998). The dividend is maintained at 12% for the year, and the balance forward is a trifle higher at £485,782.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *May* 19.

The current prices of tar products are as follows:

Pitch, 57s. 6d. per ton f.o.b.

Creosote, 3½d. to 3¾d. per gallon.

Refined tar, 4d. to 4¼d. per gallon in bulk at makers' works.

Pure toluole, 2s. 6d. to 2s. 7d.; pure benzole, 1s. 9d. to 1s. 10d.; 95/160 solvent naphtha, 1s. 8d. to 1s. 9d.; pyridine is in short supply. There is little 90/140 available, and for 90/160 grade the price is about 6s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

May 19.

The average prices of gas-works products during the week were: Gas-works tar, 24s. to 29s. Pitch—East Coast, 56s. 3d. to 58s. 9d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 56s. 3d. to 58s. 9d.* Toluole, naked, North, 2s. 0½d. to 2s. 2½d. Coal-tar crude naphtha, in bulk, North, 6½d. to 6¾d. Solvent naphtha, naked, North, 1s. 5d. to 1s. 6d. Heavy naphtha, North, 10d. to 11d. Creosote, *ex* works, in bulk, North, liquid, and salty, 2¾d. to 3d.; low gravity, 3d. to 3¼d.; Scotland, 2⅝d. to 2⅞d. Heavy oils, in bulk, North, 3⅜d. to 4¼d. Carbolic acid, 60's, 2s. 2d. to 2s. 3d. Naphthalene, £10 to £11. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *May* 19.

Market continues quite bright with a fair volume of new business being placed each day. In most cases prices are steady with indications pointing to a slight advance in the near future.

Crude gas-works tar.—The actual value is 35s. to 37s. per ton *ex* works.

Pitch.—This remains nominal at about 45s. to 47s. 6d. per ton f.o.b. Glasgow for export, and 45s. per ton *ex* works for home trade.

Refined tar.—Works are holding out strongly for a minimum of 3¼d. per gallon *ex* works naked.

Creosote oil remains distinctly scarce with prices quite attractive. B.E.S.A. Specification oil is 4d. to 4¼d. per gallon; low gravity, 4½d. to 4⅝d. per gallon, and neutral oil, 4¼d. to 4½d. per gallon—all f.o.r. in bulk.

Cresylic acid is difficult to secure in this district, available supplies being quoted as follows: Pale, 97/99%, 1s. 2½d. to 1s. 3½d. per gallon; dark, 97/99%, 1s. to 1s. 1d. per gallon; and pale, 99/100%, 1s. 4d. to 1s. 5d. per gallon—all f.o.r. in buyers' packages.

Crude naphtha is not too plentiful and value is steady at 4¾d. to 5¼d. per gallon, according to quality and quantity.

Solvent naphtha.—90/160 grade is accumulating, but quotations are unchanged at 1s. 4d. to 1s. 4½d. per gallon. In the case of 90/190 grade, the price is purely nominal at 8d. to 8½d. per gallon.

Motor benzole is only available in small quantities and commands 1s. 6d. to 1s. 7d. per gallon.

Pyridines.—90/160 grade is 5s. to 5s. 3d. per gallon, and 90/140 grade 5s. 6d. to 6s. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d		s. d	
Crude benzole	0 9	to	0 9½	per gallon at works
Motor ,,	1 4	,,	1 4½	,, ,, ,,
90% ,,	1 4½	,,	1 5	,, ,, ,,
Pure ,,	1 7⅞	,,	1 8	,, ,, ,,

New Capital Issues.

Ascot District Gas and Electricity Company.—The tenders sent in for the £20,000 4% perpetual debenture stock, which Messrs. A. & W. Richards offered on behalf of the Directors of this Company, were opened on May 15. They amounted to a total of £115,610 at prices ranging from £108 2s. 6d. down to the minimum of £102 per £100. The lowest accepted tender was at £103 10s., and the average price obtained £104%.

Contracts Advertised To-Day.

Coal.

Mansfield Gas Committee. [p. 478.]
Stockton-on-Tees Gas-Works. [p. 480.]
Stoke-on-Trent Gas Department. [p. 480.]
Tipton Gas Department. [p. 480.]

Gasholder Painting.

Wigton Rural District Council. [p. 478.]

General Stores—Tools, Paints, &c.

Birkenhead Corporation Gas Department. [p. 478.]

Lime.

Mansfield Gas Committee. [p. 478.]

Meters and Meter Repairs.

Birkenhead Corporation Gas Department. [p. 478.]
Mansfield Gas Committee. [p. 478.]

Pipes, Fittings, and Specials.

Birkenhead Corporation Gas Department. [p. 478.]

Purifying Material.

Stockton-on-Tees Gas-Works. [p. 480.]

Sulphuric Acid.

Mansfield Gas Committee. [p. 478.]

Tar.

Mansfield Gas Committee. [p. 478.]

Overseas Opportunities.

Denmark.

GASHOLDER FOR AARHUS GAS-WORKS.

The Commercial Secretary to H.M. Legation at Copenhagen reports that the Aarhus Gas-Works are calling for tenders, to be presented in Aarhus by June 19, 1934, for the supply of a 60,000 cub.m. capacity gasholder. Firms desirous of offering a gasholder of United Kingdom manufacture can obtain the further details of this call for tenders, together with particulars of the "Special Register" service of information, upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1. Reference No. A.Y.12,380 should be quoted.

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. May 18.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
1,551,868	Stk.	Apl. 9	7	7	Alliance & Dublin Ord. ...	128—138	...	137½
374,000	"	Jan. 8	4	4	Do. 4 p c Deb. ...	90—100	...	...
557,655	"	Mar. 5	7	7	Barnet Ord. 7 p.c.	165—170	...	167
300,000	1	May 7	1/4⅛	1/9⅜	Bombay, Ltd.	26/6—28/6*	...	...
178,480	Stk.	Feb. 19	9½	9½	Bournemouth sliding scale	203—208	...	...
550,050	"	"	7	7	Do. 7 p.c. max. ...	162—167	...	164½—166
439,160	"	"	6	6	Do. 6 p.c. Pref. ...	142—147	...	144—146½
50,000	"	Dec. 18	8	8	Do. 3 p.c. Deb. ...	79—84	...	...
262,025	"	"	4	4	Do. 4 p.c. Deb. ...	103—107	...	...
335,000	"	"	5	5	Do. 5 p.c. Deb. ...	121—126	...	...
357,900	"	Mar. 5	7½	7½	Brighton, &c , 6 p.c. Con. ...	161—166	...	...
540,000	"	"	6⅔	6⅔	Do. 5 p.c. Con. ...	151—156	+1	153—156
195,500	"	"	6	6	Do. 6 p.c. B. Pref.	140—145	...	...
1,487,500	"	Mar. 5	5	5	Bristol 5 p.c. max.	116—117a	+½	...
120,420	"	Dec. 18	4	4	Do. 1st 4 p.c. Deb. ...	104—106a	...	...
217,870	"	"	4	4	Do. 2nd 4 p.c. Deb. ...	104—106a	...	...
328,790	"	"	5	5	Do. 5 p.c. Deb.	123—125a	...	...
885,000	"	Apl. 9	7	8	British Ord.	153—158	...	155—156
100,000	"	Dec. 18	7	7	Do. 7 p c. Pref.	158—168	...	...
350,000	"	"	5½	5½	Do. 5½ p.c. Pref.	106—111	...	...
120,000	"	"	4	4	Do. 4 p.c. Red. Deb. ...	97—102	...	...
450,000	"	"	5	5	Do. 5 p c. Red. Deb. ...	109—114	...	...
160,000	"	Jan. 8	5	5	Cambridge 5 p.c. Deb. ...	115—120	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1½—3¼	...	...
100,000	10	Nov. 6	4½	4½	Do. 4½ p.c. Pref. ...	5—7	...	6½
150,000	Stk.	Dec. 18	4½	4½	Do. 4½ p.c. Deb. ...	95—100	...	97 97½
626,860	"	Feb. 19	6	6	Cardiff Con. Ord.	128—133	...	...
237,860	"	Jan. 8	5	5	Do. 5 p.c. Red. Deb.	103—108	...	...
157,150	"	Feb. 19	5	6½	Chester 5 p.c. Deb.	112½—122½b	...	...
98,936	1	May 7	2/-	2/-	Colombo, Ltd. Ord.	1⅞—1⅝*	...	...
24,500	1	"	1/4⅛	1/4⅛	Do. 7 p.c. Pref.	18/6 -20/6*	...	...
609,204	1	Mar. 19	/11'48	/11'48	Colonial Gas Assn. Ltd. Ord.	1—1⅛	...	21/9½
296,053	1	"	1/8'80	1/8'80	Do. 8 p.c. Pref.	23/6—25/6	...	...
1,775,005	Stk.	Feb. 19	5	6½	Commercial Ord.	120—125	...	120—120½
475,000	"	Dec. 18	3	3	Do. 3 p.c. Deb. ...	77—83	...	81
258,344	"	Mar. 5	5	5	Do. 5 p.c. Deb. ...	120—125	+1	124—125
807,560	"	Feb. 19	7	7	Croydon sliding scale ...	153—158	...	155½—157½
569,590	"	"	5	5	Do. max. div.	105—110	...	...
620,345	"	Jan. 8	5	5	Do. 5 p.c. Deb.... ...	121—126	...	...
542,270	"	Mar. 5	7	10	Derby Con.	175—180e	...	...
55,000	"	Jan. 8	4	4	Do. 4 p.c. Deb.	98—100e	...	...
209,000	"	Feb. 19	5	5	East Hull Ord. 5 p.c. ...	106—111	...	...
181,625	"	Mar. 5	6	6	East Surrey Ord. 5 p.c. ...	126—131	...	...
175,609	"	Dec. 18	5	5	Do. 5 p.c. Deb. ...	118—123	...	...
1,002,180	"	Apl. 9	15	17	European, Ltd.	122—127	...	123—125
19,342,763	"	Feb. 19	5⅜	5⅜	Gas Light & Coke 4 p.c. Ord.	96/9 -97/3f	...	26/10½—27/3
2,600,000	"	"	3½	3½	Do. 3½ p.c. max. ...	87—90	...	87½—88
4,477,106	"	"	4	4	Do. 4 p.c. Con. Pref. ...	103—106	...	104½—105½
6,102,497	"	Dec. 18	3	3	Do. 3 p.c. Con. Deb. ...	85—88	...	86½—87
3,643,770	"	"	5	5	Do. 5 p.c. Red. Deb. ...	116—119	...	118½
3,500,000	"	"	4½	4½	Do. 4½ p.c. Red. Deb. ...	114—117	...	116
270,466	"	Mar. 5	6	6	Harrogate New Cons. ...	125—130	...	...
82,500	"	Mar. 5	7	7	Hastings & St. L. 5 p.c. Conv.	147—152	...	...
258,740	"	"	5½	5½	Do. 3½ p c. Conv	115—120	...	...
140,000	1	Apl. 23	1/7½	1/7½	Hongkong & China, Ltd. ...	1⅝—1⅞	...	1½
218,200	Stk.	Mar. 5	6	6	Hornsey Con. 3½ p.c. ...	128—133	...	...
5,600,000	"	Nov. 6	14	10	Imperial Continental Cap.	214—219	+1	214—217
223,130	"	Feb. 5	3½	3½	Do. 3½ p.c. Red Deb.	89—94	...	...
235,242	"	Mar. 5	8½	8½	Lea Bridge 5 p.c. Ord. ...	169—174	...	...
2,167,410	"	Mar. 5	6	6	Liverpool 5 p.c. Ord. ...	130—132b	...	...
245,500	"	Dec. 18	5	5	Do 5 p c. Red. Pref. ...	101—111b	...	...
306,083	"	July 17	4	4	Do. 4 p.c. Deb. ...	101½—103½b	...	...
165,736	"	Feb. 19	8	10	Maidstone 5 p c. Cap. ...	180—190	...	...
56,176	"	Jan. 8	3	3	Do. 3 p.c. Deb. ...	72—77	...	...
75,000	5	Dec. 4	†10	†10	Malta & Mediterranean ...	9—11	...	...
392,000	—	Apl. 3	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	96—101	...	...
231,978	Stk.	Feb. 19	5	5	M. S. Utility "C." Cons. ...	113—118	...	...
818,657	"	"	4	4	Do. 4 p.c. Cons. Pref.	95—100	...	...
360,075	"	Jan. 8	4	4	Do. 4 p.c. Deb. ...	100—105	...	103—104
148,955	"	"	5	†5	Do. 5 p.c. Deb. ...	117—122	...	...
675,000	"	31 May '31	†6	6	Montevideo, Ltd.	60—70	...	64—65
2,061,315	"	Mar. 5	5	5½	Newcastle & Gateshead Con.	25/-—25/6d	— /3	...
682,856	"	"	4	4	Do. 4 p.c. Pref. ...	99—101d	...	...
776,706	"	Jan. 8	3½	3½	Do. 3½ p.c. Deb. ...	92—93d	...	...
277,285	"	May 7	5	5	Do. 5 p.c. Deb. '48 ...	105—107d*	...	...
274,000	"	Feb. 19	5	5	Newport (Mon.) 5 p.c. max.	106—108a	...	...
204,940	"	Mar. 19	7½	7½	North Middlesex 6 p.c. Con.	155—160	...	158½—160
393,160	"	Feb. 5	5	5	Northampton 5 p.c. max. ...	99—104	...	...
300,000	"	May 7	†3	†7	Oriental, Ltd.	155—160*	+5	159½
316,617	"	Dec. 18	8	8	Plym'th & Stonehouse 5 p.c.	165—170	...	...
504,416	"	Feb. 19	8	8	Portsm'th Con. Stk. 4 p.c. Std	168 -173	...	172—172½
241,446	"	"	5	5	Do. 5 p.c. max. ...	105—110	...	...
114,000	"	Feb. 19	5	5	Preston 5 p.c. Pref.	103—108	...	...
686,812	"	Jan. 22	4	4	Primitiva 4 p.c. Rd. Db. 1911	87—92	...	...
389,813	"	Dec. 18	4	4	Do. 4 p.c. Cons. Deb.	88—93	...	90—91
150,000	10	Mar. 19	6	6	San Paulo 6 p.c. Pref. ...	7—8	...	...
1,736,968	Stk.	Mar. 19	6	6	Sheffield Cons.	136—138e	+2	...
95,000	"	Jan. 8	4	4	Do. 4 p.c. Deb.	96—100e	...	...
133,201	"	Feb. 19	5	5	Shrewsbury 5 p.c. Ord. ...	135—140	...	...
90,000	10	June 12	15	14	South African	2¾—4½	...	...
6,709,895	Stk.	Feb. 19	5	7	South Met. Ord.	130 -133	...	130½—133
1,135,812	"	"	6	6	Do. 6 p c. Irred. Pf.	140—145	...	143—145
850,000	"	"	4	4	Do. 4 p.c. Irred. Pf.	102—106	...	104½—105
1,895,445	"	Jan. 8	8	8	Do. 8 p.c. Deb ...	84—87	...	86½
1 000,000	"	Jan. 22	5	5	Do. 5 p.c. Red. Deb.	114—117	...	116
209,820	"	Mar. 5	8½	8½	South Shields Con.	166—167d	...	...
1,543,795	"	Feb. 19	6	6	South Suburban Ord. 5 p.c.	130—133	...	130½—131½
512,825	"	"	5	5	Do. 5 p.c. Pref.	117—122	...	122
300,000	"	"	—	4	Do. 4 p.c. Pref.	103—108	...	...
868,337	"	Dec. 18	5	5	Do. 5 p.c. Deb.	121—126	...	...
100,000	"	"	4	4	Do. 4 p c. Deb.	103—108	...	...
647,740	"	Mar. 5	5	5	Southampt'n Ord. 5 p.c. max.	109—114	...	...
121,278	"	Dec. 18	4	4	Do. 4 p.c. Deb.	100—105	...	...
350,000	"	Mar. 5	5½	5½	Swansea 5½ p.c. Red. Pref.	106 -111	...	...
300,000	"	Dec. 18	6½	6½	Do. 6½ p.c. Red. Deb.	103 -108	...	106¼—107
1,076,490	"	Mar 5	6⅔	6⅔	Tottenham and District Ord.	148—153	...	151
409,835	"	"	5½	5½	Do. 5½ p.c. Pref. ...	123—128	...	...
69,235	"	"	5	5	Do. 5 p.c. Pref. ...	112 -117	...	...
199,005	"	Dec. 18	4	4	Do. 4 p.c. Deb. ...	97—102	...	...
85,701	"	Apl. 9	6	6	Tuscan, Ltd. 6 p c. Red. Db.	90—100	...	...
349,110	"	Mar. 5	7	7	Uxbridge, &c., 5 p.c. ...	150 -155	...	152—153
88,330	"	"	5	5	Do. 5 p.c. Pref. ...	112 -117	...	...
1,322,220	"	Mar. 5	7	7	Wandsworth Consolidated	156 -161	+1	158—160
1,096,373	"	"	5	5	Do. 5 p.c. Pref.	119—124	...	122½—123½
1,317,964	"	Dec. 18	5	5	Do. 5 p.c. Deb.	122—127	...	...
158,400	"	Mar. 5	5	6g	Winchester W. & G. 5 p.c. Con.	115—120	...	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f.*—The quotation is per £1 of stock *g.*—Paid £3, including 10s. on account of back dividends. * Ex. div. † Paid free of income-tax. ‡ For year.

COMPANY NOTICES.

THE MALTA AND MEDITERRANEAN GAS COMPANY, LIMITED.

TO THE PROPRIETORS.

NOTICE is Hereby Given that an ORDINARY GENERAL MEETING of the Proprietors of the Company will be held at the Offices, 5, Great Winchester Street, Old Broad Street, London, E.C. 2, on Tuesday, 5th June, 1934, at 12 o'clock noon, to receive the Report of the Directors and the Accounts for the Year ended 31st March, 1934; to declare Dividends; to consider and, if approved, to pass a resolution having for its object the conversion of the Shares of the Company into Stock; to elect Auditors and to fix their remuneration; and to transact the general business of the Company.

One of the Directors, Mr. ERNEST LIONEL BURTON, retires from office, and offers himself for re-election.

The Auditors, Mr. WILLIAM CASH, F.C.A., and Mr. HYDE CLARKE BURTON, F.C.A., retire, and offer themselves for re-election.

The TRANSFER BOOKS WILL BE CLOSED from the 23rd day of May until the day of the Meeting, both days inclusive.

By order of the Board,
G. MURRAY BURTON,
Secretary.

5, Great Winchester Street,
Old Broad Street, E.C. 2,
8th May, 1934.

THE MALTA AND MEDITERRANEAN GAS COMPANY, LIMITED.

EXTRAORDINARY GENERAL MEETING.

TO THE PROPRIETORS.

NOTICE IS HEREBY GIVEN that an EXTRAORDINARY GENERAL MEETING of the Proprietors of the Company will be held at the Offices, 5, Great Winchester Street, Old Broad Street, London, E.C. 2, on Tuesday, 5th June, 1934, immediately following the close of the Ordinary General Meeting, to be held at 12 o'clock noon, in accordance with the Notice on that behalf, to amend Article 110 of the Articles of Association.

By order of the Board,
G. MURRAY BURTON,
Secretary.

5, Great Winchester Street,
Old Broad Street, E.C. 2,
8th May, 1934.

OXIDE

CONSULT

THE BRITISH GAS PURIFYING MATERIALS CO., LTD.,
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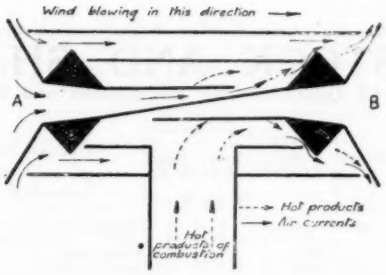
The 'Sergeant' shows some Specialities



THE A.E.M. EXTRACTOR COWL

This cowl is the invention of a Distribution Superintendent of many years' practical experience and it has made the installation of geysers, cookers, and fires satisfactory under conditions previously considered impracticable. The illustration shows the principle upon which this cowl is constructed. It is made in sheet copper and galvanised iron and is available in various sizes.

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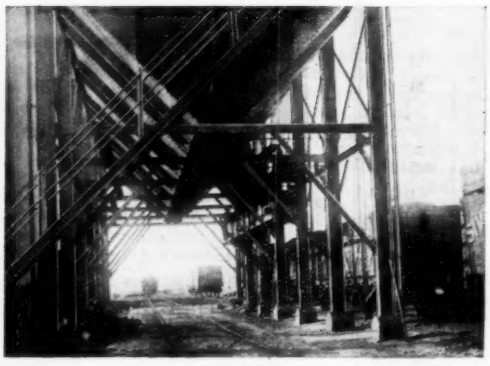

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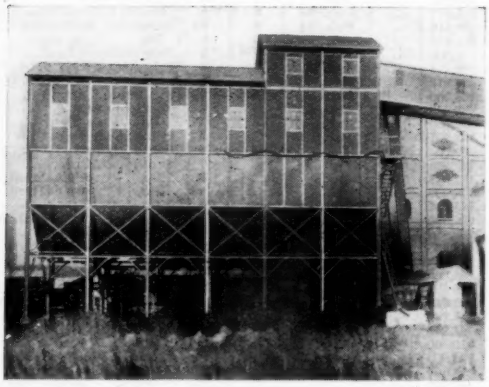

Our Technical Staff is at your service to prepare designs to suit local conditions.

Your enquiries are invited.

The New Conveyor Co., Ltd., Smethwick

Telephone: 0801 SMETHWICK — Near Birmingham — Telegrams: "APTITUDE, BIRMINGHAM."